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Plastics

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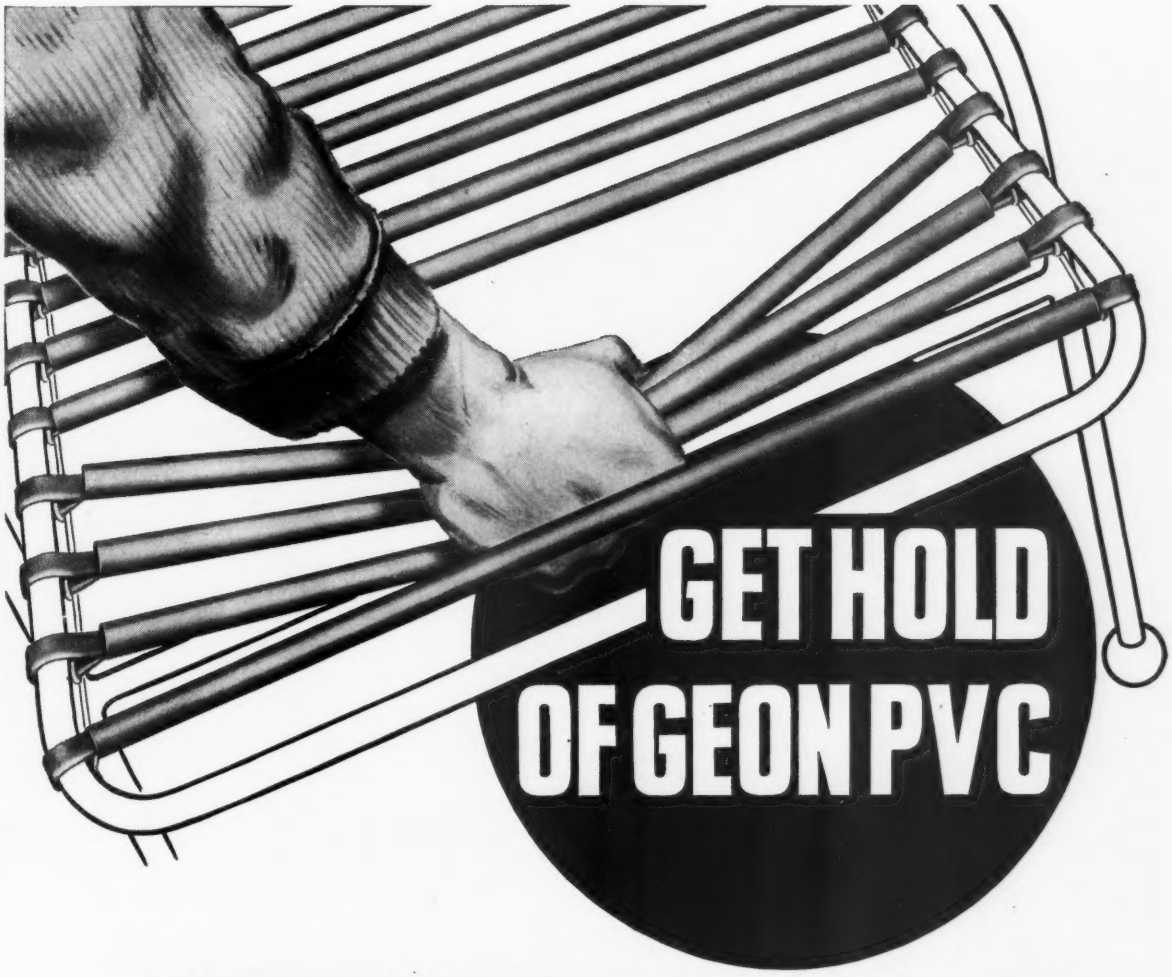

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BX Plastics Ltd. made the extrusions for the coil springs on this South Bank Festival chair from Geon PVC raw materials. Illustrations by courtesy of "Plastics".

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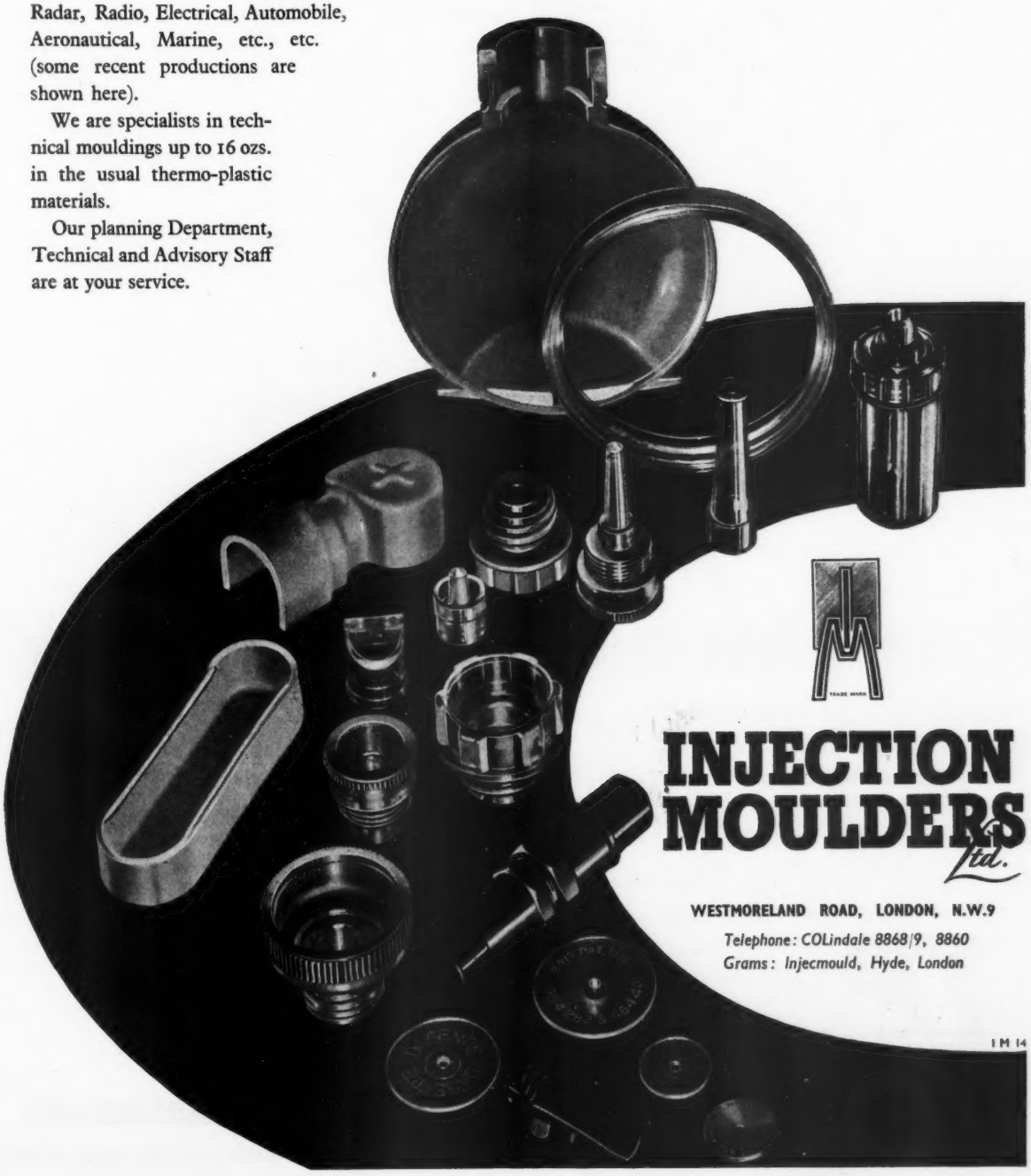

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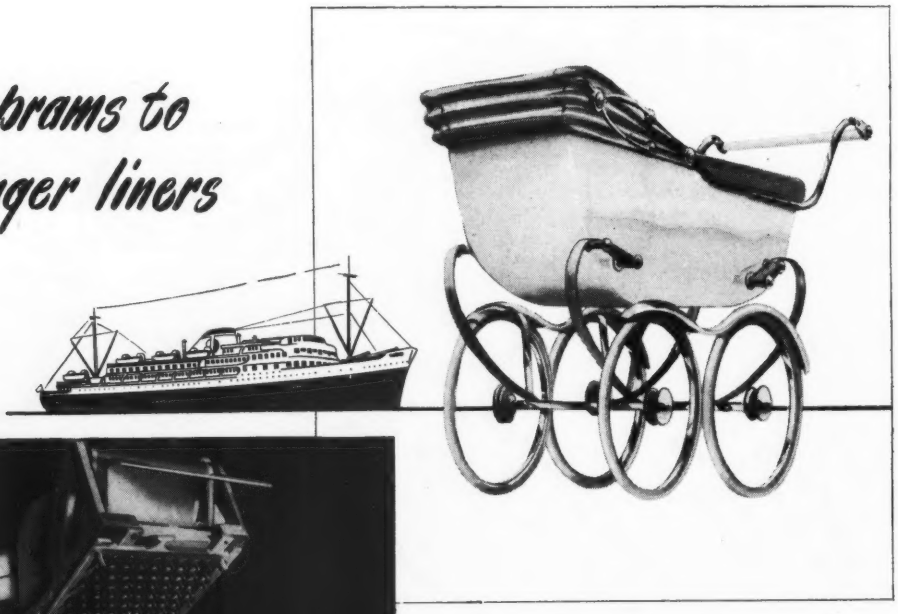

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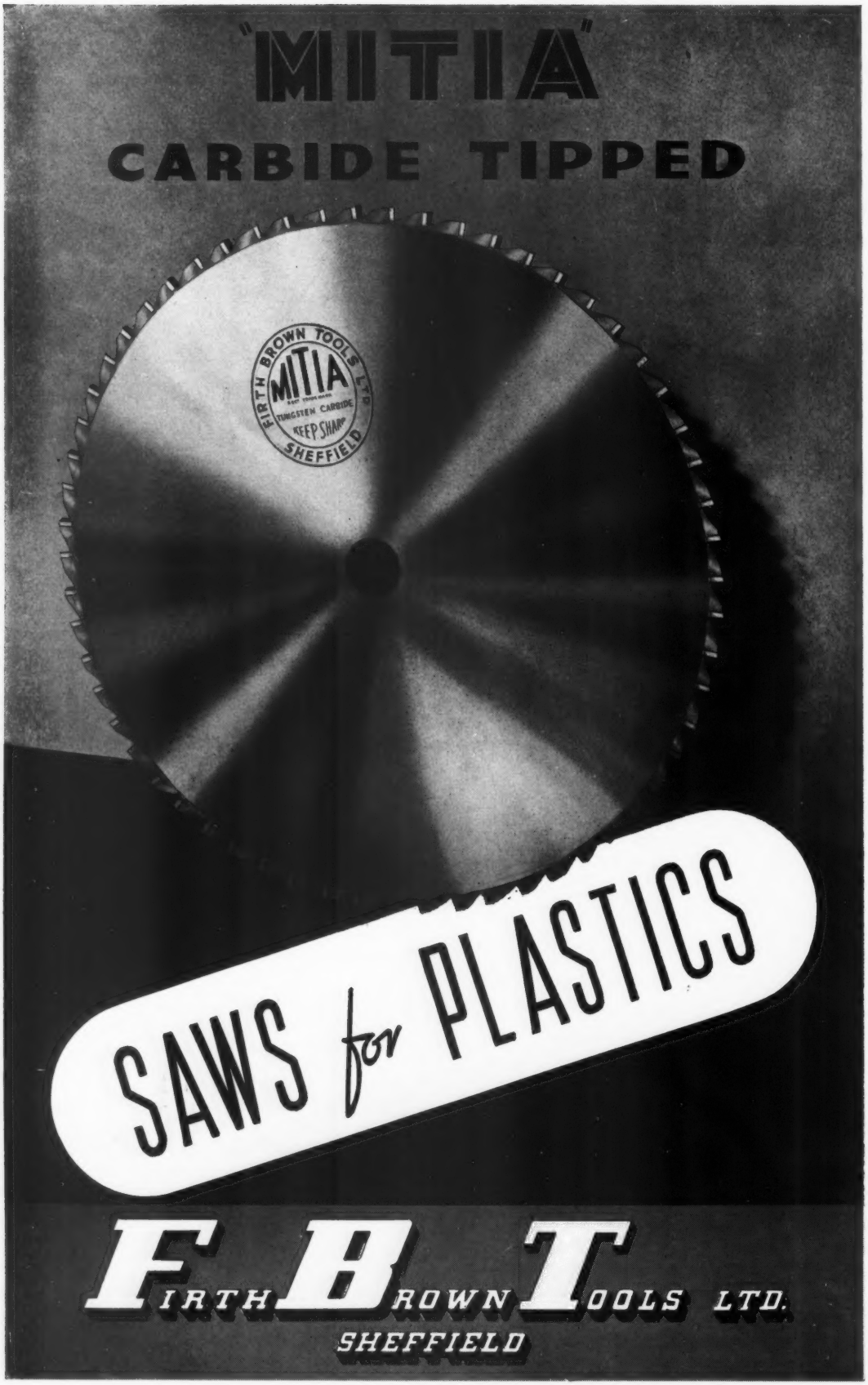
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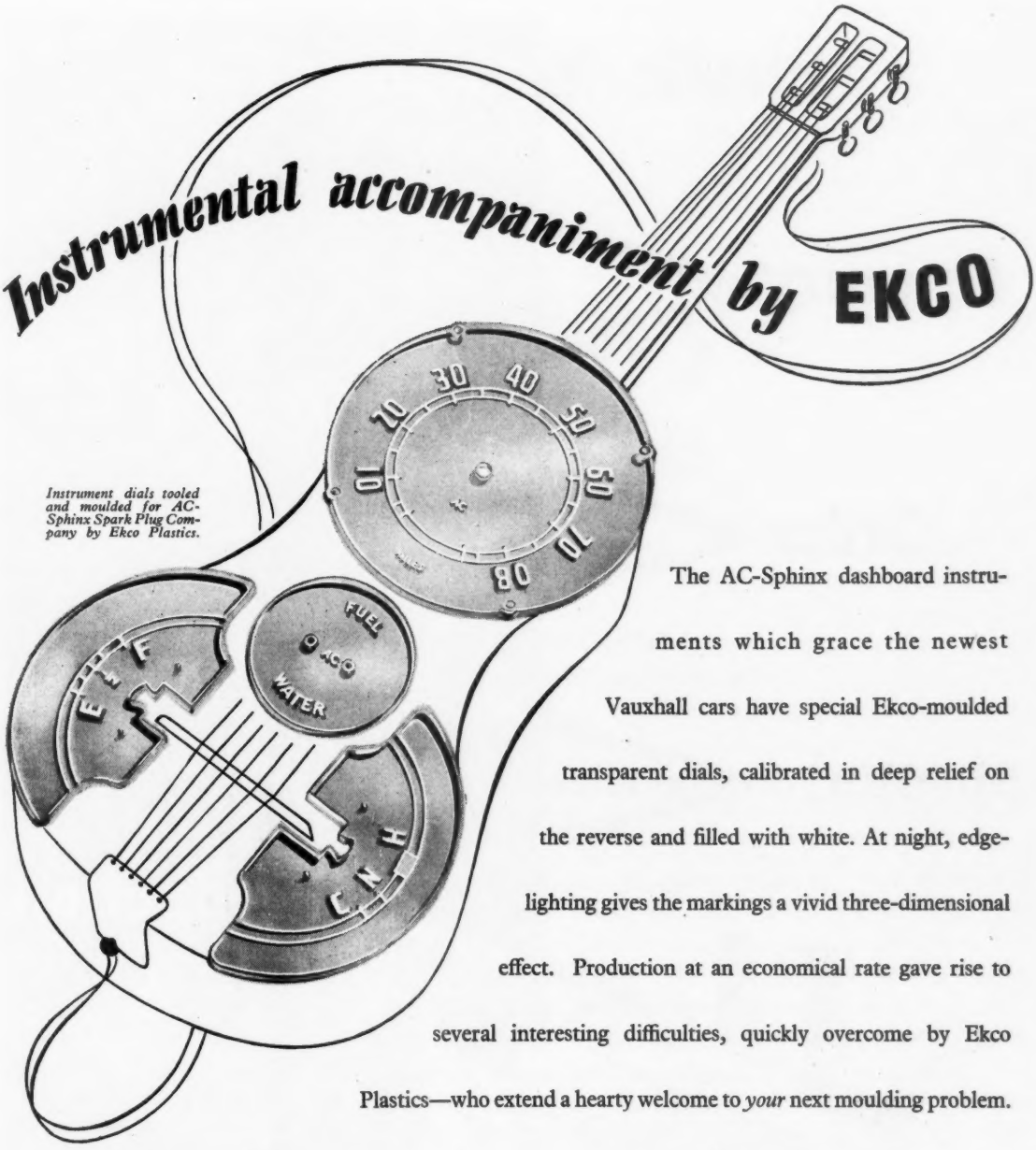

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The AC-Sphinx dashboard instruments which grace the newest Vauxhall cars have special Ekco-moulded transparent dials, calibrated in deep relief on the reverse and filled with white. At night, edge-lighting gives the markings a vivid three-dimensional effect. Production at an economical rate gave rise to several interesting difficulties, quickly overcome by Ekco Plastics—who extend a hearty welcome to *your* next moulding problem.

Technically, the following points are of interest:

The four dials are produced on one sprue. The material used is Diakon, which is resistant to attack from hydro carbons. A high degree of flatness is needed to prevent uneven refraction, and markings must be deep and clear-cut. Perfect clarity and freedom from internal faults and weld-lines are essential. To avoid softening the edges of the markings and disturbing the white fillings, a special polishing technique is employed. For a full appreciation of the service we offer, write to E. K. Cole, Ltd. (Plastics Division), Southend-on-Sea.

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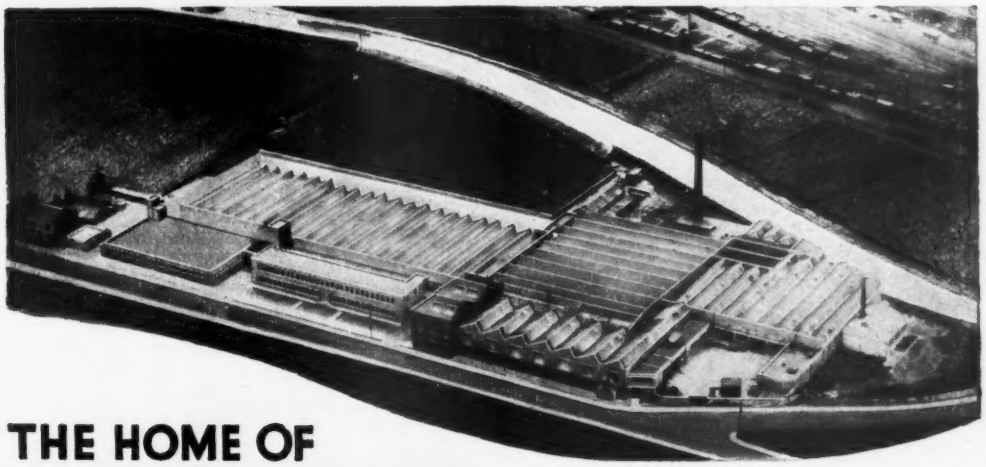

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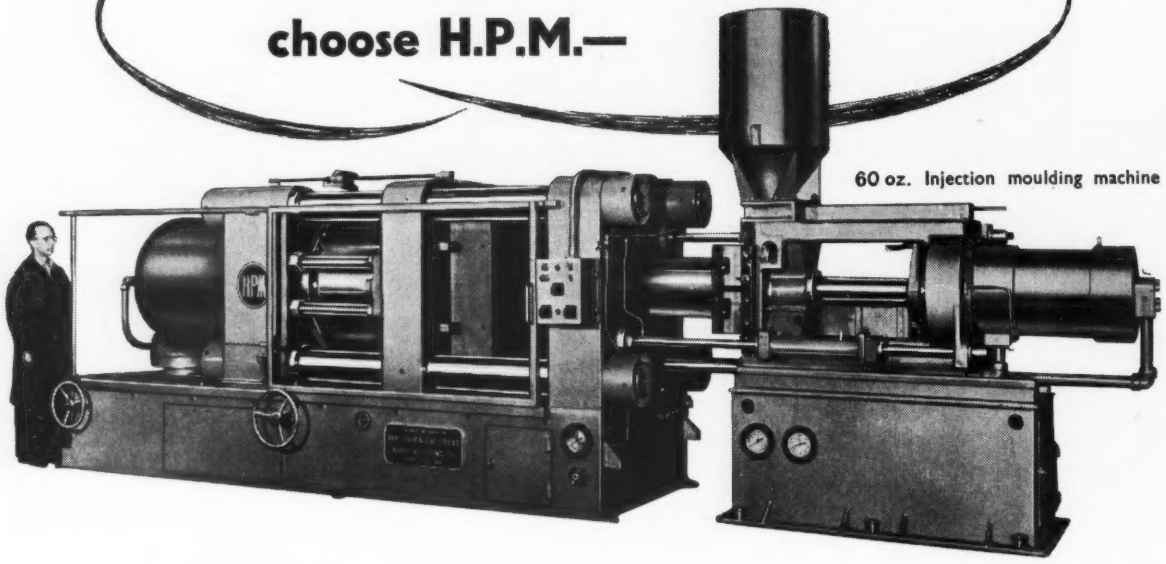

60 oz. Injection moulding machine

— and here's why

Injection moulders like the 60 oz. H.P.M. for big jobs . . . the power system is out in the open for easy accessibility . . . There's plenty of clamp pressure (1,000 tons) . . . big mould space (40" x 60") . . . lots of daylight (60") . . . and enough stroke for those deep draw jobs (36").

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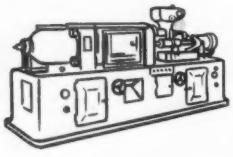
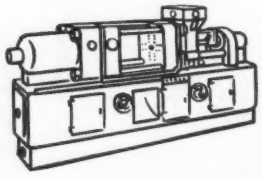
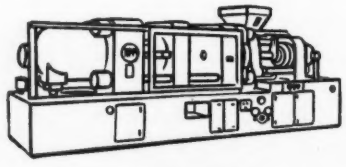


9 OUNCE



16 OUNCE



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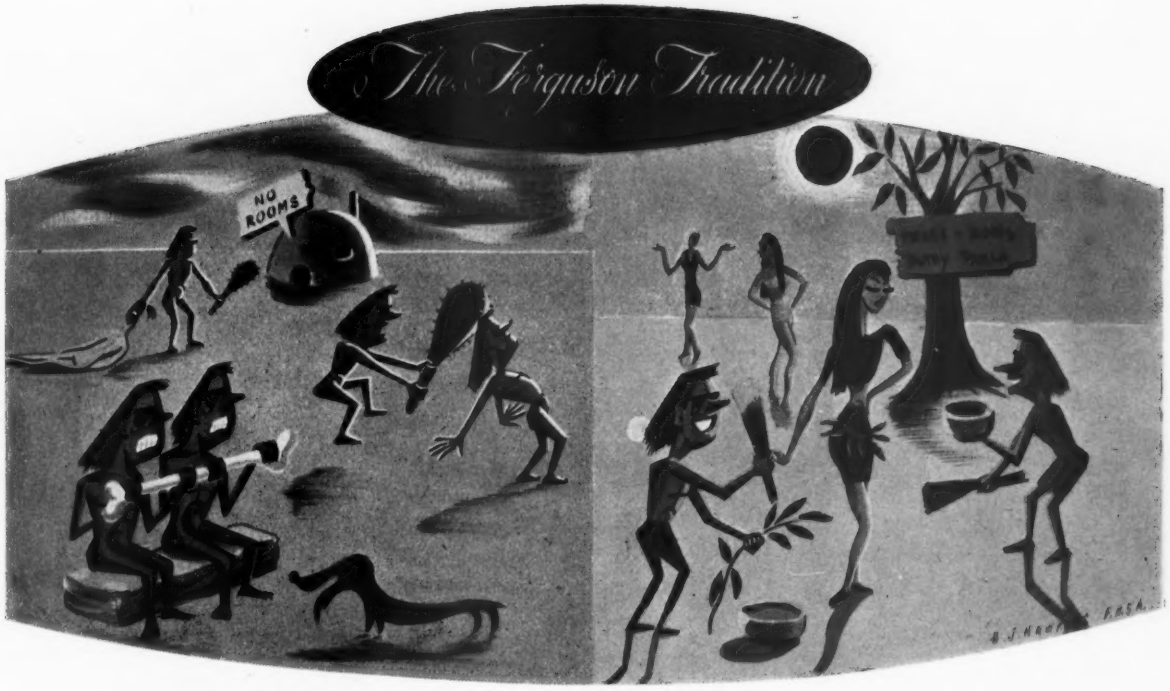


LABORATORY CONTROL

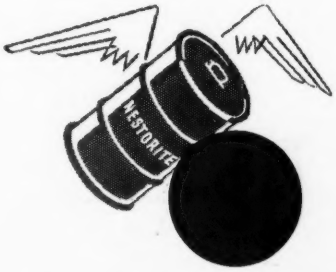
We are somewhat surprised that eminent authorities on the Stone, Neolithic, Bronze, etc., Ages, seem to have overlooked the Short Age which lasted a considerable time after the year 19510 B.C.

The existence of this Age explains the rude drawings made by primitive man on cave walls which have hitherto puzzled geologists.

During that epoch, everything was short—including tempers. So many mammoths had been killed causing a shortage of food and furs, and mankind faced the prospect of compulsory membership of the then Nudist Cult.

Ferg's Sons realised the naked truth that "necessity was the mother of convention" and by developing their father's early experiments, they produced coloured powders which, when mixed with any oily liquids, not only provided an all-over protective and plastic covering for shivering bodies, but also satisfied Mrs. Grundy. Their advertisement slogan, found scrawled on cave walls, was "Warmer than Woad" (as Ancient Britons subsequently proved).

Thus did our early Ancestors, in their very primitive laboratory, establish the present day Ferguson Principle that "The Laboratory is the Master Brain" in accurate production —a principle upon which the success of "Nestorite" Moulding Powders is firmly based.



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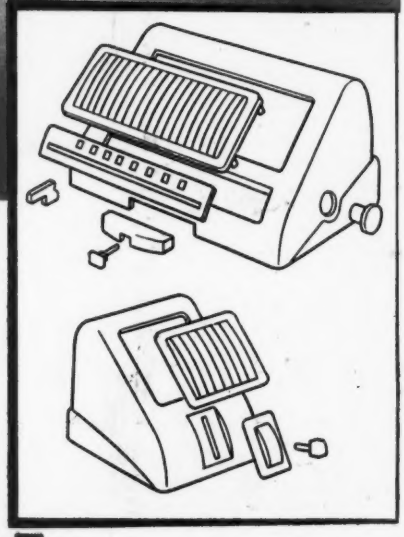

READERS may care to study another example of Insulators' moulding technique as illustrated in the "Loudspeakerphone". To ensure both functional efficiency and pleasing appearance four plastic moulding materials are used — phenolic, p.f. urea, methyl methacrylate and cellulose acetate.

Such choice of materials and close collaboration with customer on design of mouldings etc., is of course part of Insulators' normal service. But it is nevertheless moulding technique in its most proficient form, involving as it does 11 distinct and intricate moulds; this sets a seal on any firm that can execute it.

(The "Loudspeakerphone" is manufactured by The Edison Swan Electric Co. Ltd., by whose courtesy the photographs are reproduced.)

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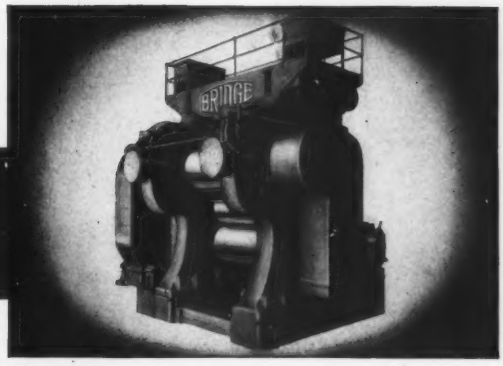
Precision Calender with three superimposed and one offset roller. Flood lubrication.



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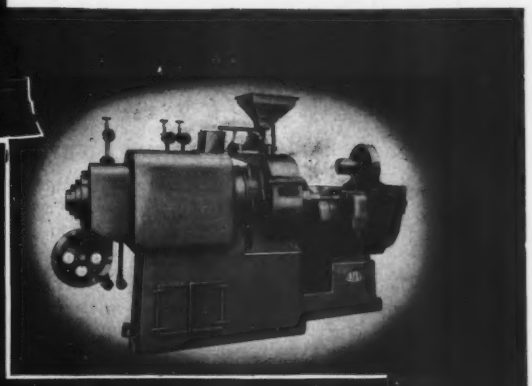
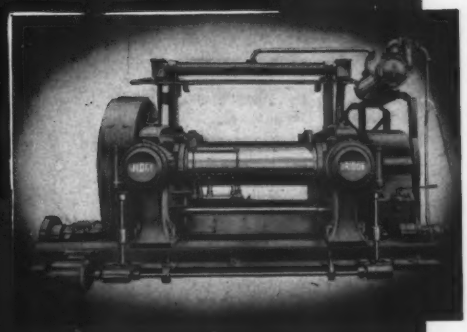
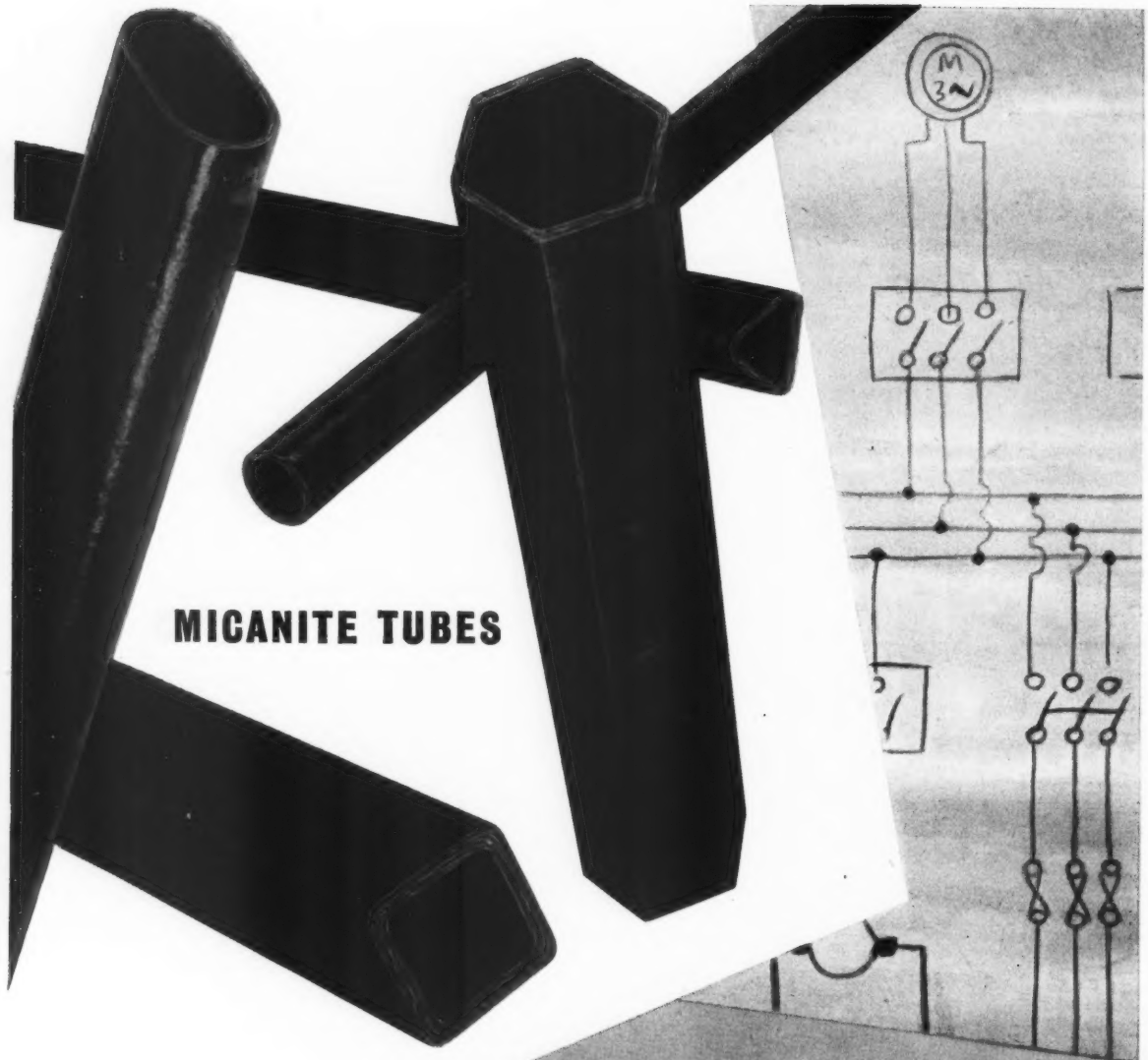
Precision Calender with four superimposed rollers. Flood lubrication. (2)

4½" Cold Feed Plastics Extruder. (3)

High temperature 22" x 60" Plastics Mill with flood lubrication. (4)







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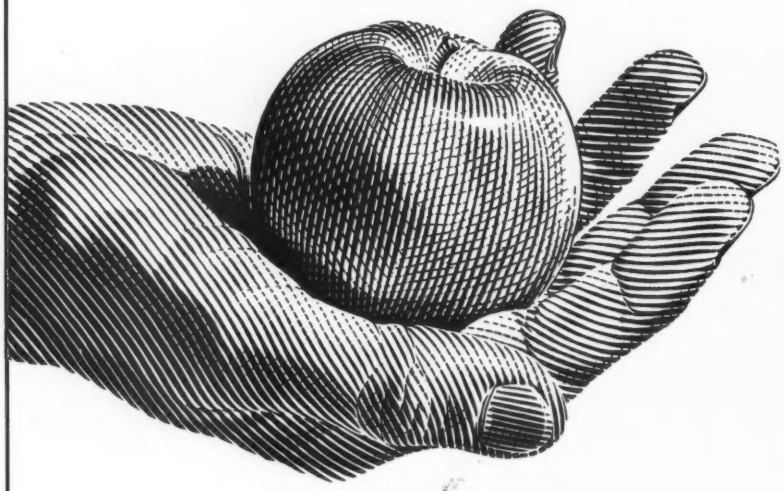

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" Really, Mr. Downs ? "

" Not at all, Mr. Ash. Nor will it warp or distort under high temperatures These bobbins we made had to fit into an intricate assembly, any discrepancy would have made them useless . . . "

" How did you do it ? "

" Well, we used a low pressure moulding with Fibreglass as a filler, Mr. Ash."

" Sounds very good, Mr. Downs."

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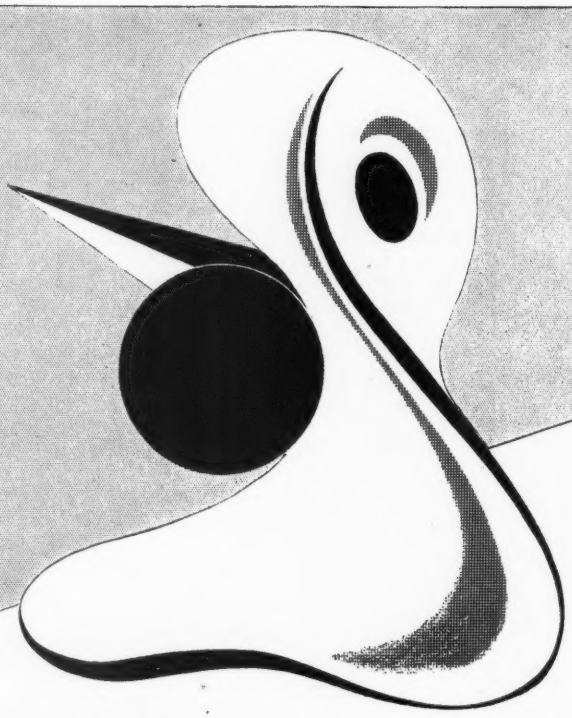
if it can be moulded in plastics, we can do it . .



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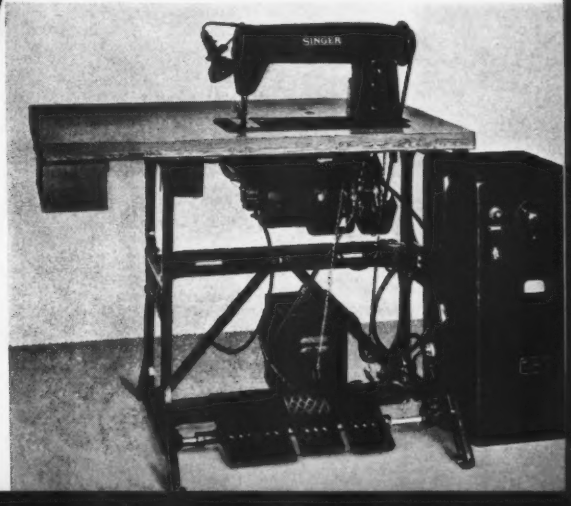

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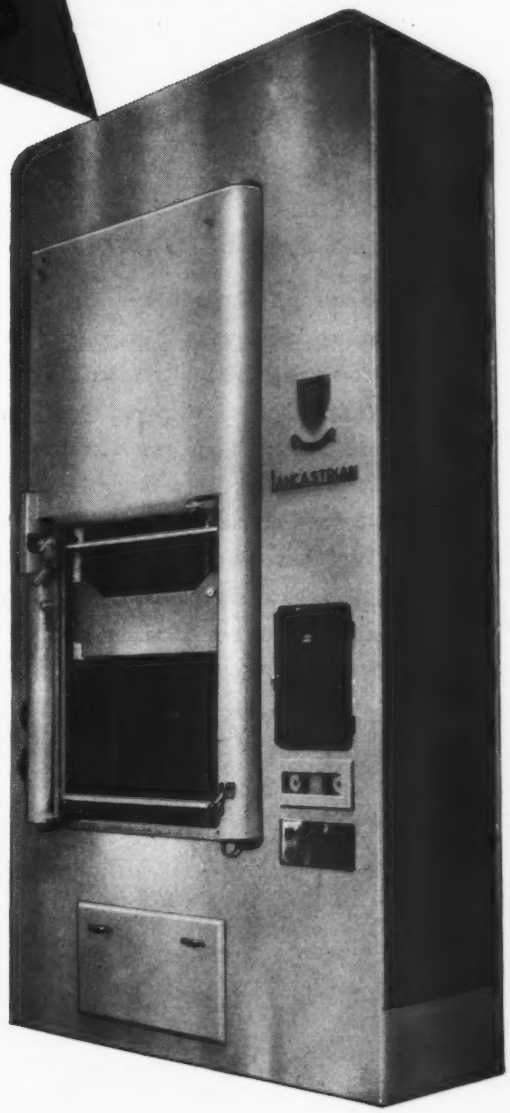

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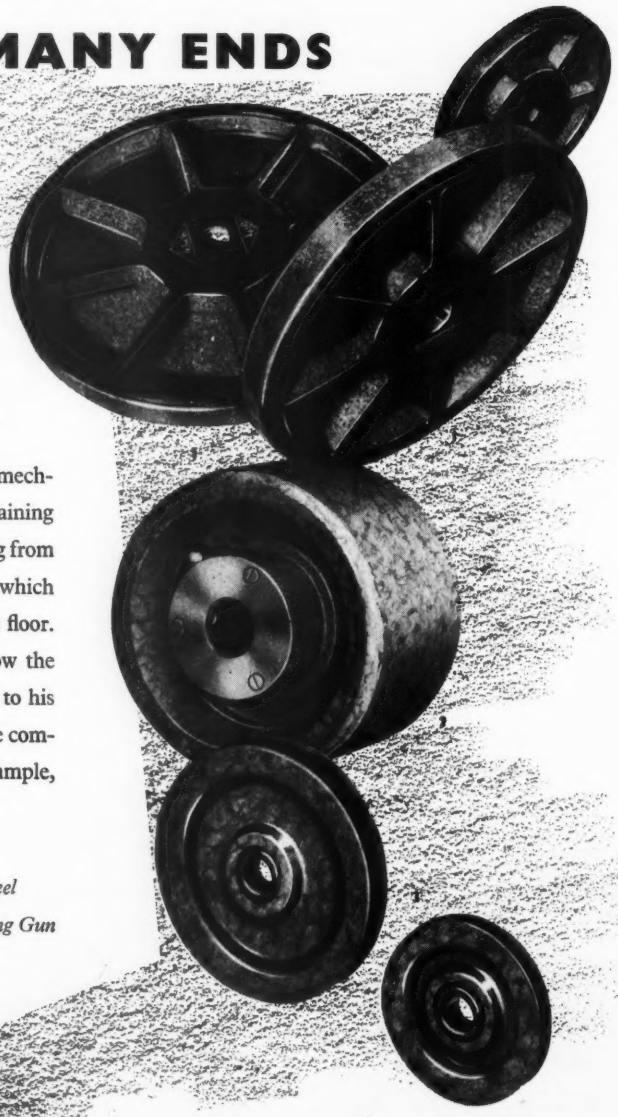

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Plastics

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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.

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Problem Comb-out

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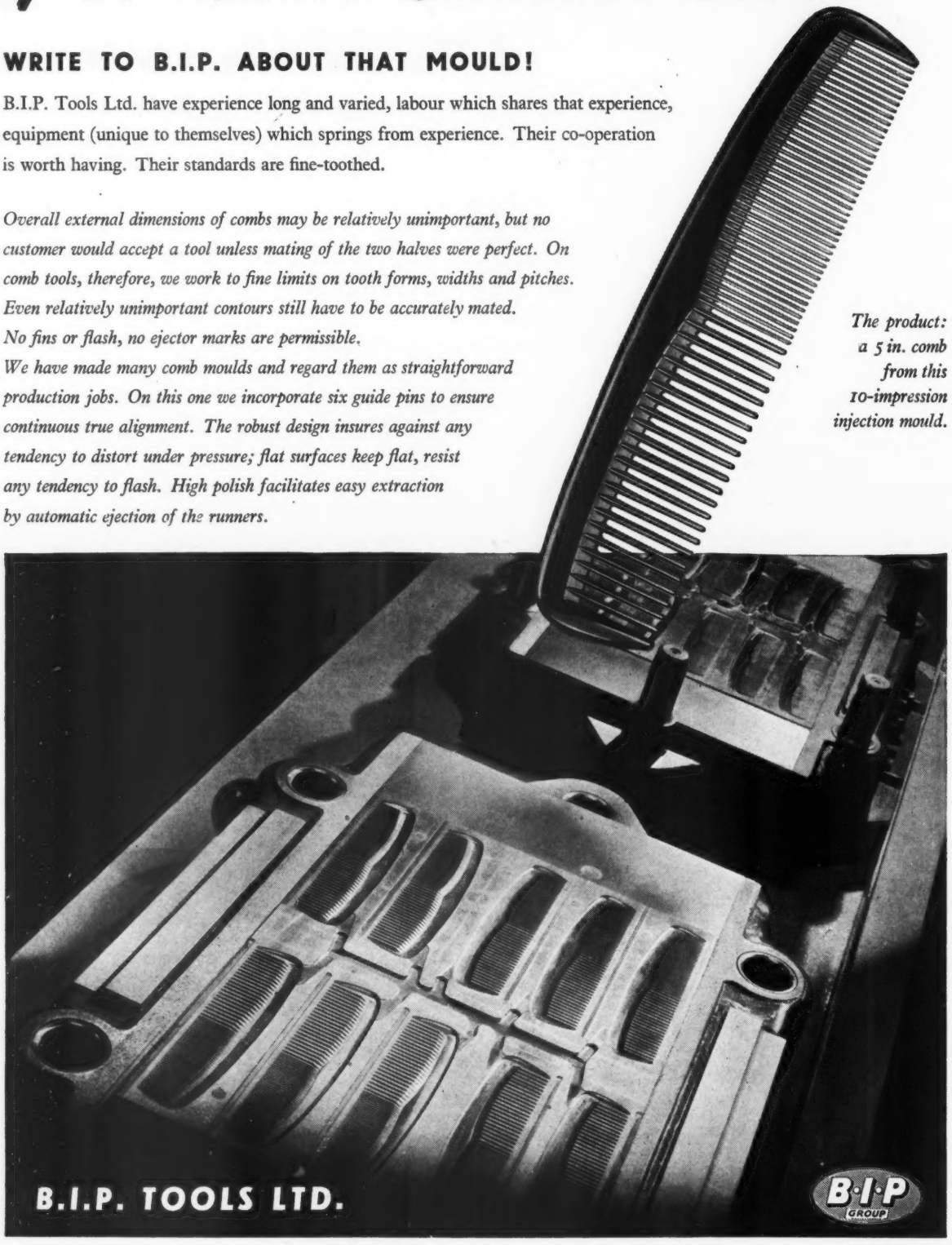
We have made many comb moulds and regard them as straightforward production jobs. On this one we incorporate six guide pins to ensure continuous true alignment. The robust design insures against any tendency to distort under pressure; flat surfaces keep flat, resist any tendency to flash. High polish facilitates easy extraction by automatic ejection of the runners.

The product: a 5 in. comb from this 10-impression injection mould.



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Plastics

VOL. XVII. No. 176. MARCH, 1952.

King George VI died on February 6th and with his death there swept through the whole Commonwealth the sudden, revealing truth of his courage, selflessness and ability. He lived and reigned through years of far greater strain and dangers than any other monarch in our long history and he lived them to do his duty. To the Queen Mother we send our deepest sympathy. To their daughter we send our wishes for a happy and prosperous reign. God save the Queen!

EDITORIALS

Moulders Productivity Team

THE news given in our February issue of the visit to the United States of a Productivity Team, chosen by the Moulders Group of the British Plastics Federation, will have been received with great interest and pleasure. It left this country on February 12 and by now is well in the midst of its study of American moulding technique, and is imparting British views and experiences to American moulders. Judging from the composition of the home team, comprising as it does some of our best representatives, the American industry will be as pleased with the results as we shall be.

On its return to this country early in April, the team will report to the British Plastics Federation on its visit; this will be followed by the publication of a printed report for its members.

We understand also that the results of the visit will be described at some future date at various meetings throughout the country; these may prove even more interesting, so far as intimate detail is concerned, than the printed report.

At a recent talk with the Chairman and the Director of the British Plastics Federation we suggested that such meetings, in view of their obvious importance to the whole of the industry, might well be thrown open also to non-members of the Federation. We have been assured now that all such meetings will be open, a step, of course, very much in line with the wishes of the Anglo-American Council.

Cost of Exhibitions

OUR remarks last month on the above subject, appear to have been widely read. It is also reported to us that a few readers have taken umbrage at the "implied slur" on organizers of exhibitions in that the editorial in question suggested that the aforesaid organizers' charges were unfairly excessive.

We would suggest to the hypersensitive a re-reading of the notes. At no point was space "rental" mentioned or discussed. We laid special stress on the high costs of the stand structures put up by the "renters" themselves, and even here made no comment as to whether such costs were unfair or not. It is a field in which prices of both raw materials and labour are especially high and everybody works feverishly under conditions of very limited time. We have never heard that the organizers of the B.I.F. considered it a slur on their space costs because the British Plastics Federation had adopted its small "window" type of exhibit in 1950 and 1951. Its erection was the result of a demand by some 20 or 30 of its constituent members, mostly moulders, who consider that the larger type of stand costs more than they can afford or are prepared to pay—it is as simple as that. A reflection of this is perhaps seen in the decision that the exclusively plastics exhibition organized by the Iliffe Press in 1951 will not again be held until 1953. This, no doubt, is a wise move because it obviously accords with the wishes of the plastics industry as a whole.

It was, therefore, proper for us to suggest methods by which these stand costs could be lowered without too great a loss of propaganda power and publicity, the most obvious being that of general co-operation and unification of design; pre-fabrication, with its attendant savings, is also a possibility.

Real and False Economies

WE hope readers will not imagine from the above, that we are at all enamoured of the small "window" stand. We are not, although we understand the reason for its creation. We do not believe it fulfils its purpose.

The plastics industry is still very much in need of an adequate shop window to show its goods to a world that knows insufficient about them. The industry is still far from able to teach the public directly, so that it would be unwise, to say the least, not to show the wholesalers, retailers and exporters, what we can provide for their customers. It would be still more unwise if we slackened our efforts in any way to capture the only partially explored fields that lie before us in all other industries where publicity and propaganda are effected more easily and where technicalities are more readily absorbed.

It is for these reasons we hope that moulders will take the very long view, will not insist too much on the expectation of immediate and direct results, and will employ more carefully conceived means to obtain their ends. It is not that we are specially devoted to exhibiting plastics at the B.I.F. Indeed, the exclusive-to-plastics exhibition with powerful, ready-made propaganda inherent in its name has already proved its value, and it is for fear that excessive cheese-paring in the one may affect the other, that we make our point.

Let us revert to our original argument. There must be methods of creating exhibitions with some economy and without loss of effect. There must be methods whereby the high standards we aim at can be achieved and which will not be replaced by low ones that neither bring us prestige nor bring us business.

Generalities

THE spending power of the public has not increased during the past month, so that recession in many branches of the plastics industry continues. The decline in clothing has affected button and the "decoration" trade, while fancy goods generally and many household goods production are seriously affected. On the other hand, reports have been received that a hard core of moulders find no diminution in new orders in the general industrial fields and in trade moulding. Ministerial encouragement to building is excellent news, since all sections will benefit thereby. The fantastic demand for telephones for new houses remains unsatisfied—the waiting list is exceptional, but here shortage applies as much to metals as to moulding powders. The demand by the Services for all electrical equipment is growing and at an ever-increasing pace. As to the general armament programme, so far as plastics is concerned in general, no spectacular movement has been noted, or, rather, all new and interesting jobs are on the secret list; however, several moulding shops report hard working on special units. Generally speaking, this interim period seems to be one of "tooling-up" for an unknown date-line rather than one of large-scale production—and, of course, there are plenty of projects on paper. At least we can mention one secret of Polichinelle, the spectacular but by no means heart-lifting production of some 3,000,000 soup plates in "urea" to the order of a Big Restaurateur.

MOULDING POWDER AND SHOT

What is a Fabricator?

I have always thought that the term "fabricator" as applied to all who work and shape some sort of rigid plastic sheet, requires a modicum of sub-classification. There are those who employ the thermoplastic type of sheet, a section that, generally clearly sub-divided in itself, produces fancy goods on the one hand and technical and industrial forms on the other. As for the fabricators using thermosetting materials, all, in contradistinction to the above, employ reinforcements in one form or another: paper, fabrics, wood veneers, asbestos, glass-fibre and so on. All products are employed in electrical engineering, mechanical engineering and constructional work. Judging from the point of view of raw materials, methods of production, methods of machining, physical and chemical characteristics and types of specifications needed in each field, the two spheres of activities have little in common so far as fields of mutual interest are concerned. The form is there, but the fact of technical collaboration appears nebulous. I am reminded of this on reading the news that a complete motor car body of glass-fibre-resin laminate has been produced in the United States and am trying to see the future of the fabricators in this country.

* * *

Gremlins Again

Mr. H. M. Quackenbos, Jr., of the Bakelite Company has made me very sad. At the Eighth Annual Technical Conference of the Society of Plastics Engineers at Chicago on January 17 he read a brilliant and valuable paper. Unfortunately he entitled it "Stress Gremlins in Thermosetting Resins"—hence these tears. Now it is obvious that the author has made a deep study of the stresses set up in mouldings, but I would respectfully suggest that he knows little or nothing about gremlins. On the other hand, I know a great deal and assure him that he is wrong in placing the blame on them. He may remember that the pilots of the R.A.F. and U.S.A.F. also blamed gremlins for the ills that aircraft were heir to. I thought I had laid this bogy to rest in my letter of December, 1944, to the Editor of "The Aeroplane," a stable companion to this journal. I have asked his permission to reproduce part of it herewith:—

> The word never appears in literature as "gremlin," but as grimlin (middle English), grandlin, granlino, granlain, etc. The meaning is obvious—the great little people—which is interesting in that a similar oxymoron was employed by Creophylos of Samos in his "Capture of Oechalia."
>
> Gremlins are certainly not mischievous. Their bonhomie is related in many a story. In Celt-Iberian times every child in Saguntum sang:
>
> Erase un granlino
> Que ponía un huevo de oro
> Al dueño cada dia.
>
> while we find an unknown English poet singing in 1300:
>
> Ichot a grimlin boure bryht
> That fully semly is on syht.
>
> Even to-day, along the Littoral we have the refrain:
>
> Qué noun cantès, qué noun cantès
> Cantès pa per ioù:
> Cantès per i granlin
> Qués auprex d'ioù.
>
> An important, perhaps the sole, representation of a gremlin in art is to be found in Toulouse-Lautrec's portrait of Marianne Cauzenec (dite Marie La Goulue), entitled "Danseuse et Grandlin," now in the possession of H. H. Ballintyre, Esq., of Boston, U.S.A. Very complete references are to be found in Rumpf and Nork's "Graemlinen und ihre Gestand in Volkesgeschichte" published in 1799 by Klebkopf of Leipzig.

To round off the whole matter I am reproducing herewith a picture I took last week at the bottom of my garden. It shows a gremlin performing his good deed for the day.

DOGSBODDY.

Unique photograph taken by moonlight of gremlin and dancing nymph.

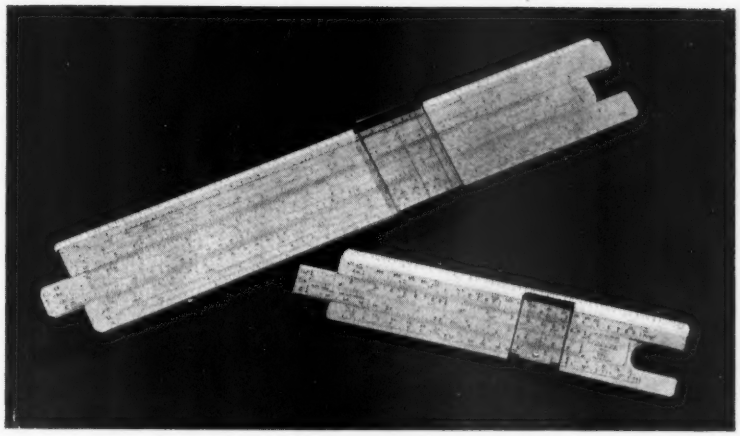


Fig. 1.—Slide rules machined from solid sheets of white "Cobex" by Blundell Rules, Ltd.

Fig. 2.—Moulding in "Cobex" sheet by Moon Aircraft, Ltd.

New Vinyl Co-polymer Sheet

WHILE by far the greater proportion of polyvinyl chloride sheet produced in the world has been of the soft, flexible type, manufactured by incorporating a medium or high content of plasticizer, there has grown since pre-war days a demand for the hard, rigid type of sheet based on the same polymer. The oldest of these has been rigid p.v.c. itself in a more or less completely non-plasticized form, which has proved so valuable as a structural material for the chemical industry. In more recent years the co-polymers have received much attention, the better known being the so-called American type based on co-polymerization of vinyl chloride and vinyl acetate, and the German type based on vinyl chloride and maleic acid ester.

A new type of hard sheet has recently been put on the market by BX Plastics, Ltd., under the name of "Cobex." It is made from a new co-polymer produced by co-polymerizing vinyl chloride and vinylidene chloride. The company has been carrying out intensive work in this field for some years, and by using a special proportion of the two monomers has produced a sheet with exceptional properties so far as dimensional stability, toughness and ease of moulding are concerned. Since the material is classed as non-inflammable, is unaffected by water and many chemicals, is a good electrical insulator, and can be obtained in a wide range of colours, its value in a wide sphere of industries is forecast.

General Features

DIMENSIONAL STABILITY. — Under all normal conditions "Cobex" is shown to be a very stable material. This is particularly noticeable under conditions of varying humidity, or even on immersion in water. At temperatures below freezing point and up to at least 50 degrees C., the maximum linear change in dimensions to be expected is 0.1 per cent. Changes in dimensions at 50 degrees C., 100 per cent. relative humidity, are as follows:—

After 1 day	+ 0.05 per cent.
After 2 days	+ 0.1 per cent.
After 14 days	no further change.

The stability of "Cobex" is also shown by the way in which sheets lie flat, without warping or twisting, under varying conditions of temperature and humidity, and after prolonged exposure periods.

NON-INFLAMMABILITY.—"Cobex" is classed as non-inflammable. When it is placed in a flame it will char, but this ceases as soon as the flame is removed.

AGEING.—As far as can be ascertained, no deterioration in

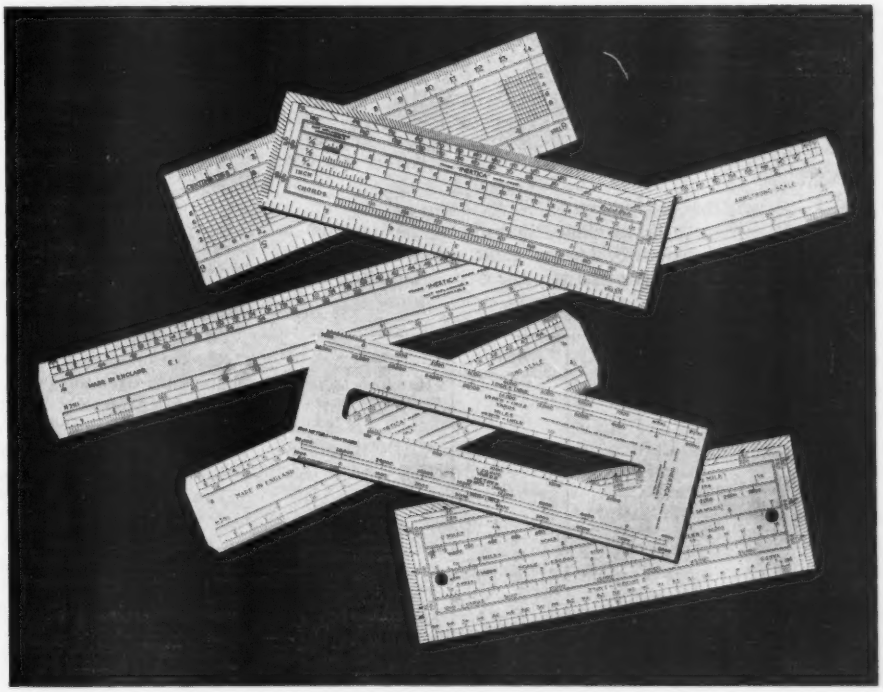


Fig. 3.—A variety of rules, with finely engraved markings, made from "Cobex" by United Chemical Engraving Co., Ltd.

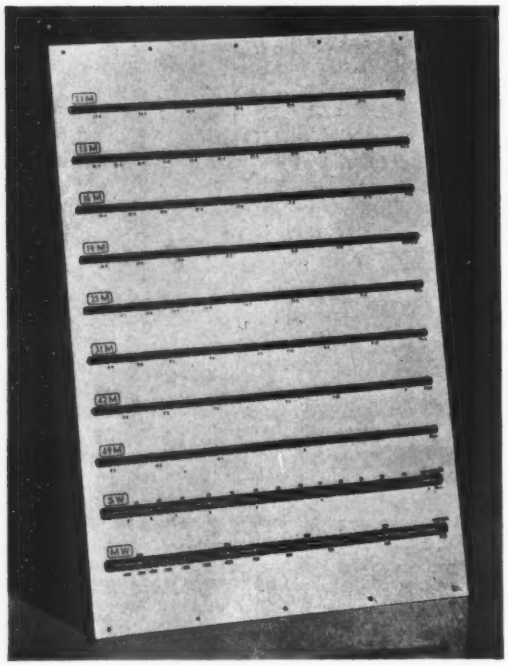


Fig. 4.—Radio dial for Kolster-Brandes Ltd., made in "Cobex" and printed by Cellgrave Co., Ltd.

any property occurs on prolonged storage under normal conditions.

EFFECT OF TEMPERATURE.—Being a thermoplastic, "Cobex" is affected by changes in temperature. It begins to soften at 76 degrees C., and can be manipulated at temperatures in excess of 90 degrees C. At temperatures below normal it becomes brittle, but this effect is not appreciable until −40 degrees C. is reached. For most purposes "Cobex" should not be used at temperatures in excess of 60 degrees C., as it can then flow if under sufficient pressure.

"Cobex" is suited for tropical applications on account of its inertness to high humidity conditions. It is not attacked nor does it support mould growth.

The physical properties of "Cobex" are set forth in Table 1; resistance to acids, alkalis, solvents, etc., are shown in Table 2. The material is resistant to most types of lubricating oils and greases, but softening is experienced with some oils, such as "Iranolin."

Machining

"Cobex" can be easily machined by most of the standard processes current in woodworking technique, and it is possible to turn out intricate parts quickly. The main point to note

Table 1.—Physical Properties of "Cobex"

Specific gravity	White	1.45
	Other colours	1.35-1.40
Tensile strength	—	6,000-7,000 lb./sq. in.
		400-500 Kgm./sq.cm.
Elongation at yield	—	4 per cent.
Impact strength (Hounsfield)	—	0.4-ft./lb./inch of notch
Youngs' modulus	—	3×10^5 lb./sq. in.
Cold bend	—	-55 to -60°C.
Water absorption (24 hours)	—	0.04 per cent.
Water absorption (10 days)	—	0.1 per cent.
Water vapour permeability	—	0.4 grm./sq.cm./cm./24 hours
Softening point	—	76°C.
Permittivity	50 c.p.s.	3.76
	800 c.p.s.	3.34
	1,600 c.p.s.	3.32
	1.4 mc/s.	3.03
Power factor	50 c.p.s.	0.05
	800 c.p.s.	0.016
	1,600 c.p.s.	0.04
	1.4 mc/s.	0.018
Dielectric strength	—	350-360 volts/mil

Fig. 5.—Road sign (white, black and yellow "Cobex") made by H. Newsum, Sons and Co., Ltd., Gainsborough.

Fig. 6.—Photographic shutter for J. H. Dallmeyer, Ltd., made in "Cobex" by Newman and Guardia, Ltd.

is that adequate cooling must be provided and sharp, hard tools have to be employed.

Cementing and Hot-air Welding

Special cements are available for use with "Cobex." They have been developed to overcome the inertness of the material, and can be used to stick the material to itself, paper, fabrics, wood, or BX p.v.c. sheet.

As an alternative to cementing, hot-air welding is a valuable method of joining "Cobex" to itself. This is particularly so in the case of butt- or angle-welds, when the surfaces to be joined are relatively small in area. The bond achieved by hot-air welding is strong but not invisible, and this method is therefore chiefly used for strictly functional applications, such as the fabrication of chemical equipment.

The equipment needed consists of a filler rod of $\frac{1}{8}$-in. diameter and a hot-air torch. The latter are available in various designs, but essentially all are capable of directing a stream of air, heated to 200 degrees C. by means of electricity or acetylene gas. The edges of the sheet are first bevelled slightly. The end of the welding rod is then placed in the groove made by two bevelled edges of sheet, and the stream of hot air directed with slight circular motion at the junction of the three materials. As the rod softens, it falls into place in the groove.

Table 2—Chemical Properties of "Cobex"

Acids	
Hydrochloric acid, concentrated and dilute	No effect
Nitric acid, concentrated and dilute	No effect
Sulphuric acid, concentrated and dilute	No effect
Glacial acetic acid	No effect
Formic acid	No effect
Oleic acid	No effect
Alkalis	
Sodium hydroxide (caustic soda)	No effect
Potassium hydroxide (caustic potash)	No effect
Sodium carbonate	No effect
Ammonia, concentrated and dilute	No effect
Oxidizing Agents	
Potassium permanganate, 10%	Surface staining (removable)
Potassium dichromate, 40%	No effect
Bromine water	No effect
Solvents	
Acetone	Soluble
Methyl ethyl ketone	Soluble
Cyclohexanone	Soluble
Tetrahydrofurane	Soluble
Benzene	Insoluble, but softens
Methyl alcohol	No effect
Ethyl alcohol	No effect
Carbon tetrachloride	No effect
Formaldehyde 40%	No effect
Aqueous Salt Solutions	
Sodium chloride, saturated	No effect
Zinc chloride, 10%	No effect
Calcium chloride, 10%	No effect
Copper sulphate, 20%	No effect

Moulding Technique

"Cobex" can also be moulded in all thicknesses, to produce strong and stable mouldings. The extent of deformation can be very small—a matter of a few thousandths of an inch, as in the case of printing plates—or else as large as shown by caravan sinks and lighting troughs.

The basic principle in moulding is to deform the sheet while hot, and leave it to cool before extracting from the mould. A temperature of 100-160 degrees C. is required, depending on the technique involved; ovens may be heated by gas or electricity. The duration of stay in the oven should be sufficiently long for the sheet to be heated uniformly throughout, remembering that "Cobex" is a poor conductor of heat. The actual time will depend on thickness; a sheet $\frac{1}{8}$-in. thick will require about five minutes.

Too much time should not be allowed to lapse between removing the sheet from the oven and beginning the drawing operation. In the case of sheet $\frac{1}{8}$ in. thick there is a safety interval of about 30 seconds.

There are several ways in which "Cobex" can be moulded. For example, the sheet can be blown or sucked into a female mould. This method relies on only one mould for shaping, with the hot sheet forced into place either by compressed air or by evacuation. It is chiefly employed in making troughs for lighting and other purposes, but there must be a flat-top surface against which the hot sheet can be clamped to make an air-tight seal.

The evacuation technique is probably the easier to control. It must be remembered, however, that an air outlet has to be provided at the lowest point of any depression. If this can coincide with an intended bolt hole, or something similar, so much the better. (See A and B, Fig. 7.)

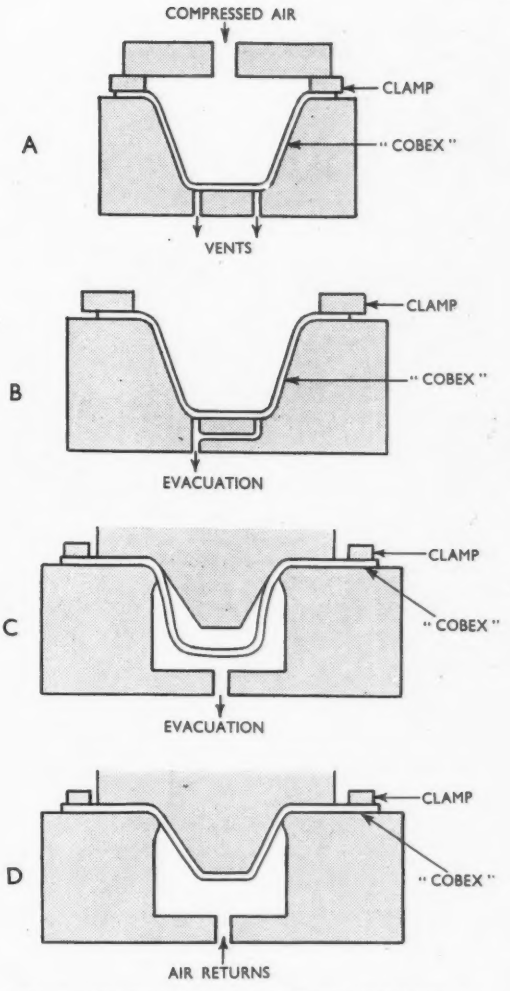


Fig. 7.—Diagrams illustrating different techniques for moulding "Cobex" sheet.

Another method of moulding is that of sucking down and then shrinking back on to a male mould. There are, indeed, many forms for which it is easier to fabricate a male mould rather than a female mould.

Using the "snap-back" technique, the hot sheet is first clamped into position and drawn by evacuation into a large cavity. The male mould is lowered at the same time, but a little more slowly, so that it does not touch the sheet. When it registers with the top flat surface, the vacuum is released, whereupon the sheet snaps back on to the tool. The moulding is removed on cooling in the usual way. (See C and D, Fig. 7.)

Forthcoming Meetings

Mar. 19.—"Some Aspects of Welfare in the Plastics Industry," R. W. Caws, Plastics Institute, North Eastern Section. Lecture Hall of the Miners' Institute, Newcastle, 7 p.m.

Mar. 21.—"Melamine and Melamine Resins," R. F. Goldstein, Plastics Institute, Midlands Section. James Watt Memorial Institute, Great Charles Street, Birmingham, 6.30 p.m.

Mar. 26.—"The Planning of the Fawley Refinery," G. Noble, Society of Chemical Industry, Chemical Engineering Group, Birmingham. Joint Meeting with Birmingham Section and Midlands Branch, Institution of Chemical Engineers.

Mar. 28.—"Practical Do and Don't in Tool Design," J. Butler, Plastics Institute North Western Section, Engineers' Club, Albert Square, Manchester, 6.45 p.m.

Mar. 31.—Annual Luncheon, Plastics Institute, Midlands Section. Queen's Hotel, Birmingham.

Apr. 2.—"Fibre Forming Polymers," R. J. W. Reynolds, Plastics Institute, London Section. Wardorf Hotel, Aldwych, London, W.C.2, 6.30 p.m.

Apr. 8.—"Heat Transfer to Boiling Liquids at Low Temperatures and Elevated Pressures," A. G. Monroe, H. A. Bristow, and J. E. Newell, Society of Chemical Industry, Chemical Engineering Group, Burlington House, London.

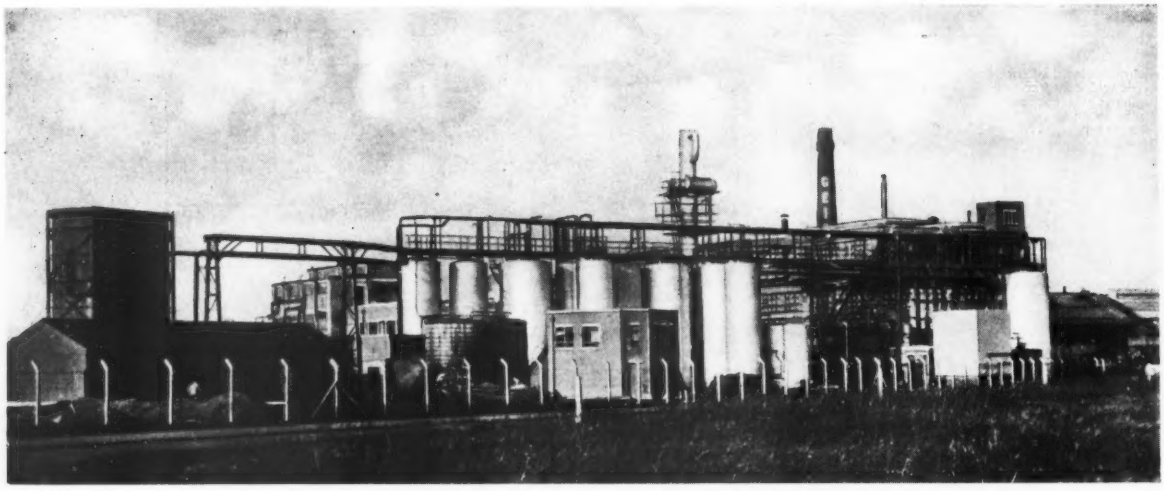


Fig. 1.—General view of the new unit for making sebacic acid at Trafford Park, Manchester.

Sebacic Acid for the Plastics Industry

SEBACIC acid has been known chemically for many years, but its use in industrial chemistry and its manufacture on a large scale is relatively very new. Since it is a dibasic acid it can be used as are other dibasic acids, e.g., phthalic, adipic, maleic, etc., for the manufacture of ester plasticizers, as polyamides, such as nylon, and as polyesters, including alkyd resins; upon the choice of the acid largely depend the characteristics of the finished material. The use of sebacic acid provides polyamides, alkyds and polyesters of specially important characteristics.

The availability of sebacic acid in a highly purified form, produced in England for the first time, has come about through the co-operation of The Geigy Company, Manchester, and the Hardesty Chemical Co., Inc., New York. At the newly-erected plant at Trafford Park, the process employed is based on that used in the United States, with castor oil (containing 88-90 per cent. ricinoleic acid) as starting point. The process is one of alkaline fusion under critically controlled conditions. At temperatures up to 200 degrees C., methyl hexyl ketone and ω-hydroxy decanoic acid are first formed, and the interaction of these two compounds at still higher temperature yields sebacic acid and capryl alcohol.

Owing to the severe foaming of the highly viscous reaction mass, capacious fusion pots of special design are used. It is, indeed, not easy to heat castor oil to very high temperatures and keep the mass in a homogeneous form. Heating must be rapid and even, but any tendency to overheating has to be carefully avoided.

At the conclusion of the reaction, the sebacic acid is present as sodium sebacate, with capryl alcohol as an aqueous distillate. The free acid is precipitated directly from the sebacate solution with sulphuric acid, and is filtered off in partially purified form for use in the manufacture of derivatives. Alternatively, the sebacate is decolourized and filtered, and sulphuric acid is added to precipitate the free acid, which is recovered by filtration, and washed and finally spray dried.

Sebacic acid as manufactured by the Geigy-Hardesty Co., Ltd., is a free-flowing powder of 98.5 per cent. purity. Its solubility in water is less than 0.1 per cent. at 20 degrees C. It is, however, freely soluble in alcohols, esters and ketones.

Di-ester Plasticizers

The reaction of sebacic acid with monohydric alcohols gives rise to a very useful series of esters, of which the dialkyl esters are of particular importance, as they have viscosities less sensitive to change of temperature than have the corresponding esters of phthalic, adipic and phosphoric acids.

A number of the commercially available dialkyl esters, e.g., dibutyl and dioctyl sebacates, are excellent plasticizers. By virtue of their viscosity/temperature characteristics, polymer compositions in which they are incorporated possess a correspondingly low temperature sensitivity in their physical properties. When such plasticizers are used with polyvinyl

Fig. 2.—Reaction vessels for the manufacture of derivatives of sebacic acid.

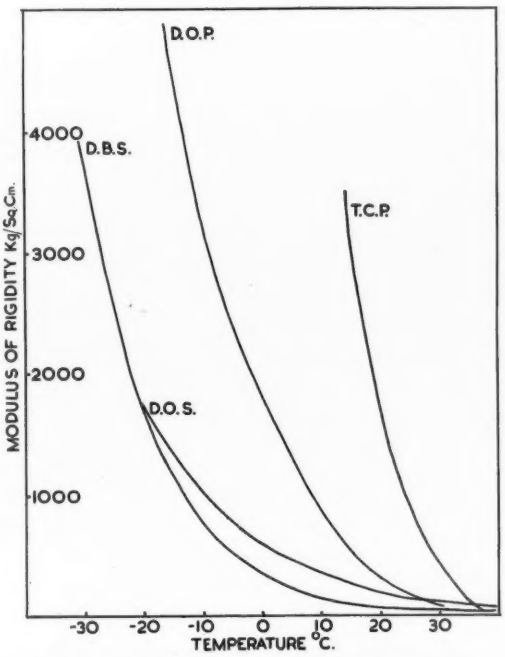


Fig. 3.—Curve showing modulus of rigidity at different temperatures for p.v.c. with different plasticizers. (p.v.c./plasticizer ratio 70/30.)
D.B.S., dibutyl sebacate. D.O.P., dioctyl phthalate.
D.O.S., dioctyl sebacate. T.C.P., tricresyl phosphate.

chloride, such properties as hardness, moduli of elasticity and rigidity are less subject to the effects of temperature, compared with p.v.c. compounded with other well-known plasticizers.

Dialkyl sebacates are therefore employed as plasticizers when polymer compounds have to conform to low temperature specifications. In addition, the volatility of one of these esters, namely, dioctyl sebacate, is extremely low, being of the same order as that of tricresyl phosphate, and hence good ageing characteristics are also achieved.

Dibutyl sebacate combines low viscosity with high solvent power; it has a powerful softening action on cellulose nitrate and its use in p.v.c. pastes is unique in combining low viscosity with long shelf life. Dicyclohexyl sebacate is a versatile plasticizer for many polymers, in particular giving excellent

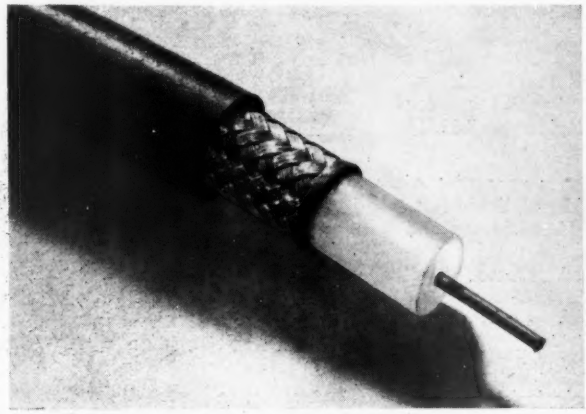


Fig. 4.—The p.v.c. sheathing which covers this polythene-insulated high-frequency cable is plasticized with a sebacic acid polyester to ensure freedom from plasticizer migration.

Fig. 5.—Low temperature flexibility tests on strips of p.v.c. quickly distinguish those containing dioctyl sebacate as plasticizer, since the material remains flexible at temperatures as low as —50° C.

light-fastness and flexibility in cellulose nitrate films. Dioctyl sebacate in p.v.c. is particularly stable to heat and efficient at low temperatures.

Due to their attractive viscosity properties, coupled with low volatility and oil solubility, the higher alkyl esters of sebacic acid, e.g., dioctyl sebacate, are also finding favour as additives to lubricating oils and for the production of low-temperature greases.

Polymeric Applications

Synthetic resins of the alkyd or polyester type produced from sebacic acid by reaction with glycerol, pentaerythritol, etc., as such or modified with lauric, palmitic, ricinoleic or other long-chain fatty acids are used in the surface coating and floor covering materials industries.

Synthetic materials of the polyester type made by reaction with dihydric alcohols, such as 1 : 2 propylene glycol, give rise to highly viscous liquids—the so-called " polymeric plasticizers "—which are a most recent innovation in the plasticizer field. On account of their high molecular weight they are non-volatile and do not diffuse from any polymer with which they are used as plasticizer. These materials are the so-called " non-migrating " plasticizers. Polypropylene sebacate, for example, is non-volatile and has no tendency to migration (e.g., into polythene cable covering) or to heat-marring of other plastics with which it may be in contact. It gives superior ageing performance in cellulose nitrate and polyvinyl chloride films, and also low sensitivity to changes in temperature; and in actual plasticizing action it is nearly as efficient as the usual monomeric types of plasticizer. It therefore constitutes a practical compromise between conventional and resinous plasticizers, to a large extent combining the plasticizing efficiency of the former with the permanence to heat, solvent-extraction, etc., of the latter.

Sebacic acid also finds applications in the production of synthetic fibres of the polyamide type. Variations of nylon are being produced on an industrial scale by using sebacic acid in place of adipic acid. Products from sebacic polyamide in the form of monofilaments are used as bristles, tennis-racquet strings, fishing lines, etc., with improved resistance to water. By the choice of diamine, suitable combinations arise for use in fibre manufacture, and partial admixture with terephthalic acid in the Terylene series gives new polymers applicable as plastic materials, as distinct from textiles for which the ethylene-glycol terephthalic acid polyester is itself most suitable.

World's Industry Employs Plastics

INDUSTRIAL APPLICATIONS

Nuts and bolts of low carbon steel, encased in vinyl plastics, produced by B. F. Goodrich Chemical Co., are replacing stainless-steel nuts and bolts and special rubber sealing gaskets for corrosive chemical baths. (" Materials and Methods," 1951/Dec./82.)

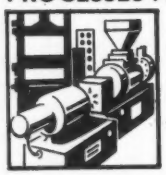
Pipes of cellulose acetate butyrate, produced by Green Contracting and Engineering Co., Wichita, Kan. from " Tenite II," provided with suitable fittings, have proved to be useful in the oilfields owing to their toughness and corrosion resistance. (" Materials and Methods," 1951/Dec./83.)

Polyvinyl alcohol and polyvinyl acetal are used for dressing polyamide fibres owing to their high mechanical strength and water solubility. G. Schulz discusses the properties and applications. (" Kunststoffe," 1951/Dec./429.)

P.T.F.E. impellers are used on a stainless-steel pump for chemical processes. The pumps also have a P.T.F.E.-packed stuffing box and a choice of P.T.F.E. or " Graphitor " self-lubricating bearings. (" Engineers Digest," 1952/Jan./26.)

Electric motor.—Main structural components are of moulded plastics (Plaskon Alkyd); metal is used only in electrical and magnetic circuits, in shaft and assembly screws. The 1/100 h.p. motor, 19,000 r.p.m., 28-volt d.c., produced by Rexford Plastics, is mainly intended for small blowers. (" Product Engineering," 1952/Jan./195.)

PROCESSES : MACHINERY



Flame spraying: E. Gemmer reports on experience with flame-sprayed plastics coating for complicated workpieces. (" Kunststoffe," 1952/Jan./P3.)

Gluing laminated materials.—E. J. Ritter reviews the various clamping methods with which wooden components to be glued are fixed temporarily together; mechanical clamping means, pressure tubes and hydraulic clamps are described. ("Kunststoffe," 1952/Jan./P5.)

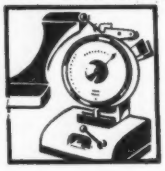
The action of the screw injection press has been investigated both theoretically and experimentally by W. Meskat, who gives production rate, mixing capacity, homogenization of the material and energy consumption. (" Kunststoffe," 1951/Dec./417.)

Production of a miner's helmet by compression and injection moulding is described in detail by H. Turnwald. The mould is based on the German standards for plastics moulds. (" Kunststoffe," 1952/Jan./P1.)

The cementing of seams, considered as a new method in the Russian textile trade, is described by V. G. Fedenjuk. (" Legk. Promysl " (Moscow), 1951/Vol. 11, No. 11/16).

Development of injection moulding: It is contended that injection moulding is an ideal, one-operation production process. New developments are the production of large-size and heavy components. ("Kunststoffe," 1951/Dec./431.)

MATERIALS and TESTING



Copolymers. — P. Kraenzlein discusses the development and fabrication of copolymers of asymmetrical dichlorethylene and vinyl chloride, known in America as " Saran " and in Germany as " Dioxit." The production of threads and bands by screw injection presses is described, as well as the importance of plasticizers and colour stabilizators. (" Kunststoffe," 1951/Dec./421.)

Polymer degradation.—A symposium was held at the National Bureau of Standards, Washington, in September, 1951, to discuss the following plastics: Saran, nylon, polyvinyl chloride, polyacrylonitrile, polyethylene, polystyrene and the cellulose esters and ethers. (Nat. Bur. Standards, Technical News Bulletin, 1952/Vol. 36/13.)

Vinyl Resin Plastisols, consisting of finely divided polyvinyl resins dispersed in a phase of liquid plasticizer and stabilizer can be moulded or applied by dip-coating. With adequate heat they gelatinize. Properties and applications are described. (" Product Engineering," 1952/Jan./154.)

The elastic and viscous properties of polystyrene in the solid and liquid state were reviewed by W. H. Mohrman and coll. The influence of the working conditions was investigated. (Journ. Appl. Chem., 1951/Vol. 1/456-469.)

Testing plastics.—P. J. van Wijk discusses the special material properties of macromolecular materials, under consideration of their rheological behaviour. The relationship between stress and deformation and the effect of time is stressed in particular. (" Kunststoffe," 1951/Dec./442.)

The bursting strength of artificial leather was determined by H. Mendrzyk by means of a bell-shape fixture whereby a circular piece of the material is exposed to one-sided pressure. (" Kunststoffe," 1952/Jan./13.)

The inflammability of spectacle frames was tested recently. Of 30 samples suspended on a wire hook and ignited with a common safety match, 26 ignited and were considered a definite source of danger to the wearer. ("Am. Journal Ophthalmology," Dec., 1951; " Manufacturing Optician," 1952/Feb./259.)

Glass-reinforced plastics with high impact strength, consisting of matted glass fibres combined with thermosetting resins, is produced by Libby-Owens-Ford Glass Co., Toledo 6, Ohio, and supplied to moulders in ready-mixed form. (" Product Engineering," 1952/Jan./216.)

MISCELLANEOUS USES

Injection moulding cellulose esters: W. Roehm reviews structure, properties, application and manufacture of the various types of organic cellulose esters. (Kunststoffe," 1951/Dec./434.)

Plastics and the designer.—G. B. von Hartmann explains the problems of the designer in a number of examples. He claims that it is not yet possible to give the designer sufficient data about plastics, so that he can calculate the strength of his components in the usual way. The values determined on testpieces cannot be transferred to actual components. (" Kunststoffe," 1951/Dec./438.)

Production of foamed material.—H. Lindemann reports on the production of foamed material made from rubber or thermoplastics. Difficulties in the production of uniform and dimensional stable shaped bodies could be overcome. (" Kunststoffe," 1952/Jan./9.)

COATINGS and ADHESIVES

Vinyl resin coatings protecting refinery equipment include exterior of caustic tanks, sulphur dioxide blowdown tanks, acid plant areas exposed to sulphur dioxide, etc. (" Oil and Gas Journal," 1951/Oct. 18/100.)

Silicone water repellent for masonry surfaces has been developed by Dow Chemical Co. It excludes moisture, does not change colour or fill pores of masonry. (" American Builder," 1951/Nov./214.)

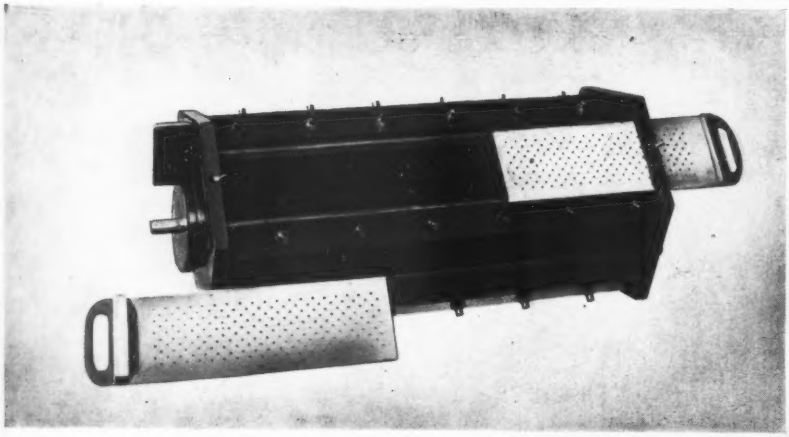
"The Symbol of Light"

This head, carved in "Perspex," is the work of Dr. A. J. Fleischmann, and was the outstanding exhibit at a recent display of "Perspex" sculpture arranged by I.C.I. Ltd., Plastics Division, at their offices at Welwyn Garden City. The head was commissioned for Philips Gloiėlampenfabrieken N.V., Eindhoven, Holland, as a present from overseas agents to celebrate the company's 60th anniversary. It is 30 ins. high, with a base 10 ins. square, and has been carved from one block of "Perspex," measuring 31 ins. × 12 ins. × 11 ins., made by a special lamination process.

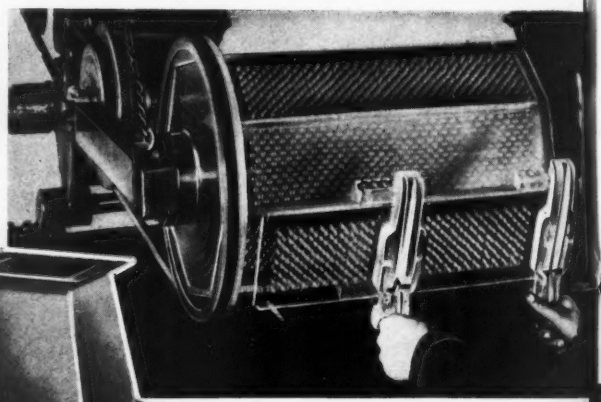
PLASTICS
IN THE SERVICE OF MAN

A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

26. Chemical Industry—1.



(Above) Acid resistance is of primary importance for these open-ended plating barrels moulded in ebonite by W. Canning and Co., Ltd.

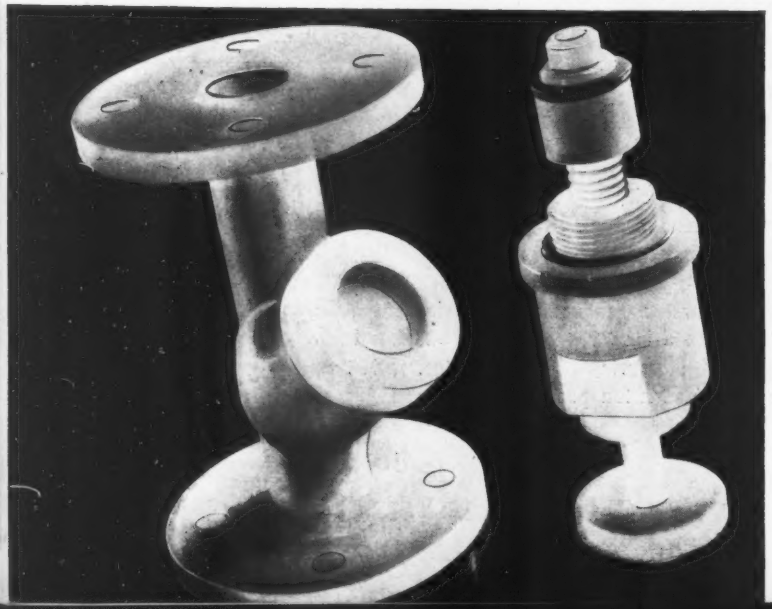


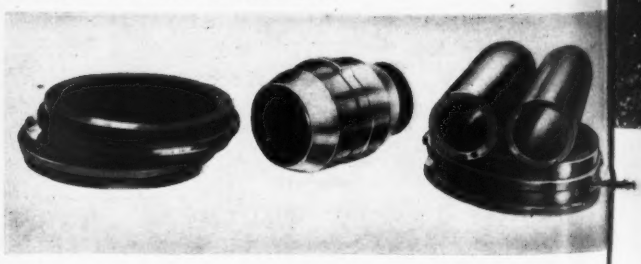
(Above) Because they combine ease of fabrication with excellent mechanical and acid-resistant properties, phenolic laminates are used by W. Canning and Co., Ltd. in the manufacture of barrels for the plating industry.

(Above) Transparent "Perspex" acrylic sheet is also used by W. Canning and Co., Ltd. to fabricate plating barrels which permit inspection during the plating operation.

(Below) Corrosion-resistant valve components are fabricated by Rockweld Limited from "Alkathene" polythene made by Imperial Chemical Industries, Ltd. Plastics Division. (Photo: I.C.I.)

(Left) Lip extraction ducting for hydrogen fluoride and other fumes fabricated by Prodorite Ltd., from ½-in. p.v.c. to fit a tank 3 ft. x 2 ft.

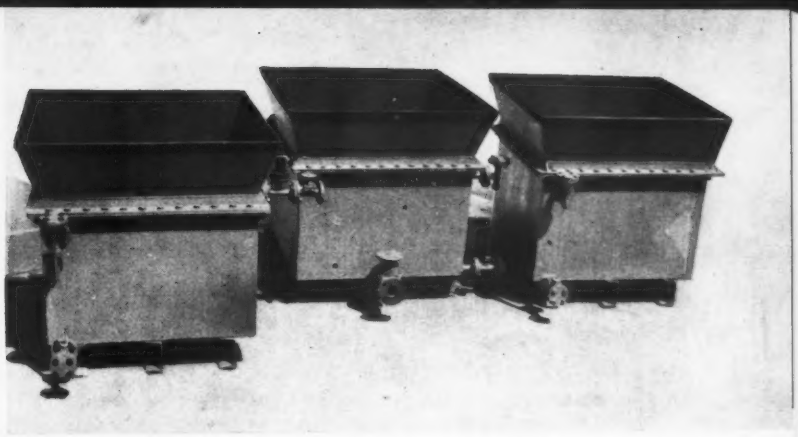




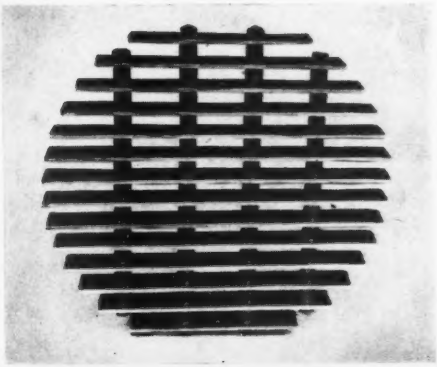
(Above) Sleeves, neck-rings and brushes made of "Tufnol," for a chemical pump—lubricated only by the corrosive solutions which it handles. (Photo: Tufnol, Ltd.)

(Above) "Plasoco" protective clothing for workers in the chemical industry is manufactured from fabric-reinforced plastics material by Ioco, Ltd.

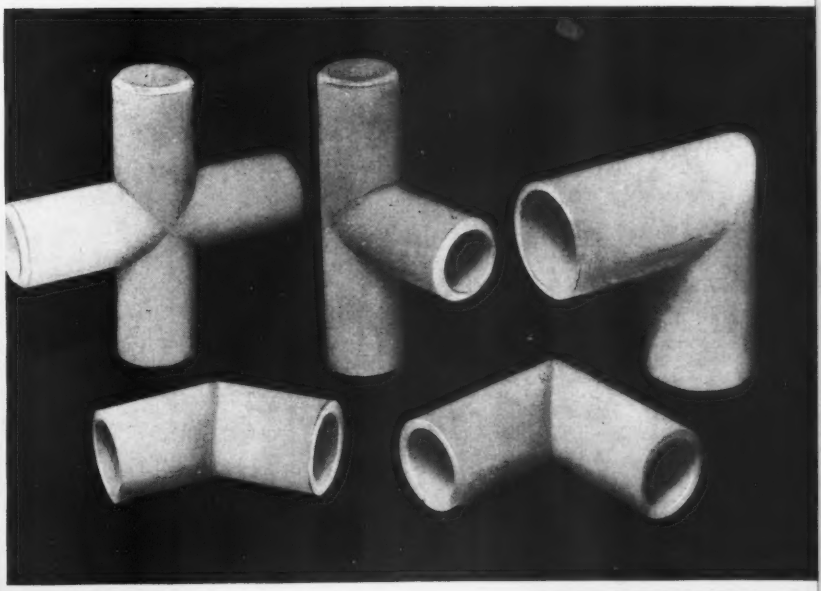
(Right) Prototype drum for lighter handling of chemicals in powder form was manufactured by Thermo-Plastics, Ltd., from reinforced cellulose acetate. ("Plastics," July, 1951, p. 200.)



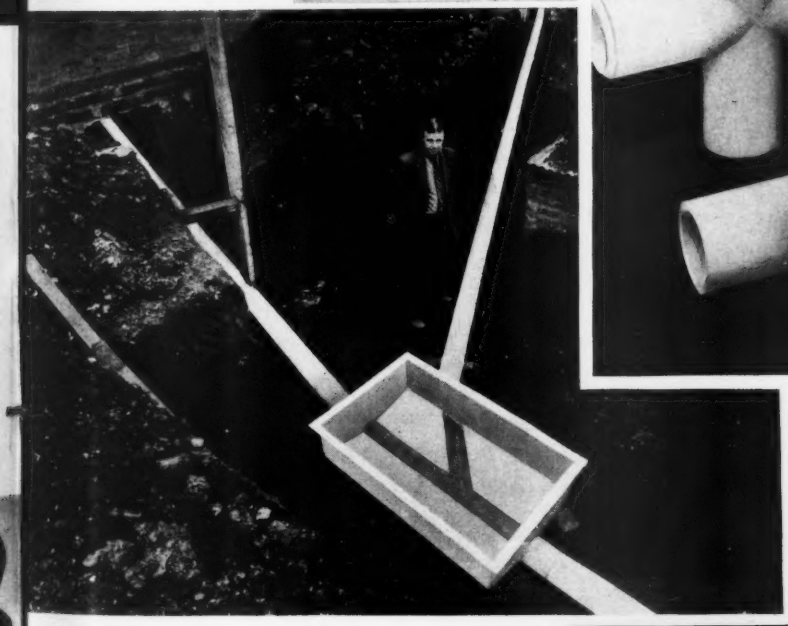
(Above) Group of vacuum filters lined by Nordac, Ltd., with corrosion-resisting "Vulcoferran."



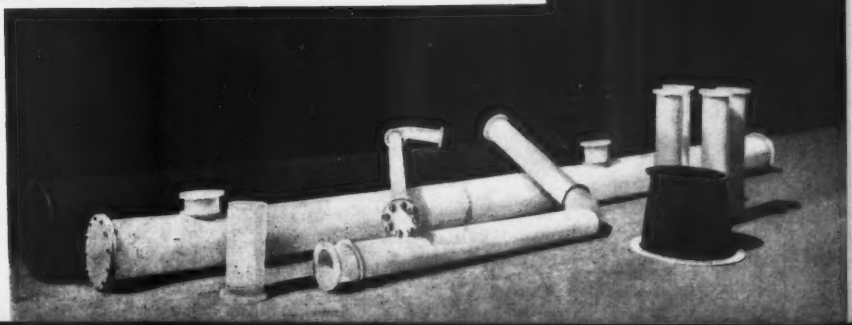
(Left) Tower-filling support grid for British Filters, Ltd., manufactured entirely from "Ferobestos" laminates made by Ferodo, Ltd. ("Plastics," July 1951, p. 198.)



(Above) Pipe joints and elbows are moulded from "Alkathene" polythene by the Chemical Pipe and Vessel Co., Ltd. (Photo: I.C.I.)



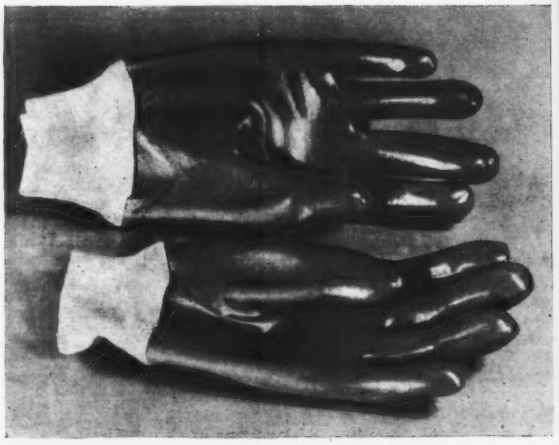
(Above) Effluent drainage installation in polythene, executed by Prodorite, Ltd., Plastics Division, for I.C.I. Ltd., at the Witton works of Amal, Ltd., showing a manhole and lengths of 6-in. diameter pipe work.



(Right) Spun and extruded polythene tubes made by Prodorite, Ltd., Plastics Division, with diameters from 3 to 16-ins. and ¼-in. wall thickness.

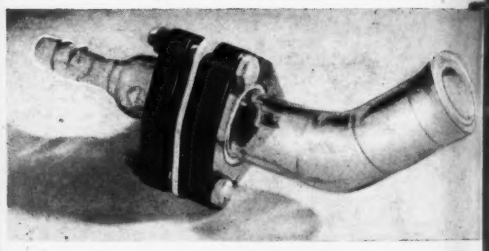
(Left) An open view of a chemical pump made entirely of "Tufnol" laminates. (Photo: Tufnol, Ltd.)

(Right) One pair from a range of p.v.c. industrial gloves made by James North and Sons, Ltd., for workers handling acids and other chemicals. ("Plastics," December, 1950, p. 288.)



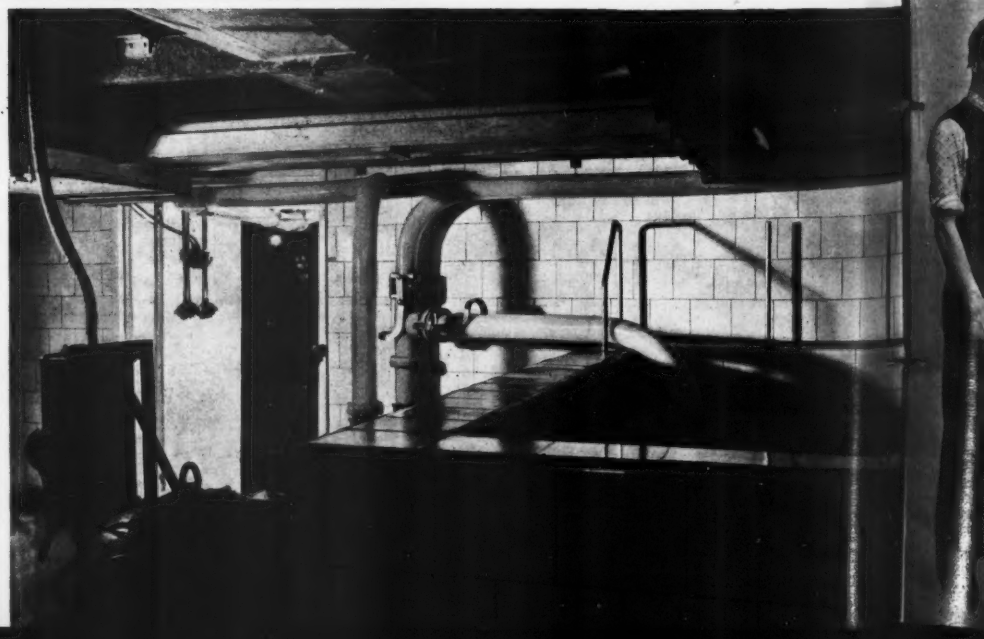
(Below) Light-coloured laminates make ideal hygienic working surfaces for handling fine chemicals. Cream "Warerite" is used on the packing tables of Allen and Hanburys, Ltd.

(Above) The usefulness of the polythene carboy syphon made by Airothene, Ltd., has been enhanced by the addition of a self-starter pump, also injection moulded in polythene.

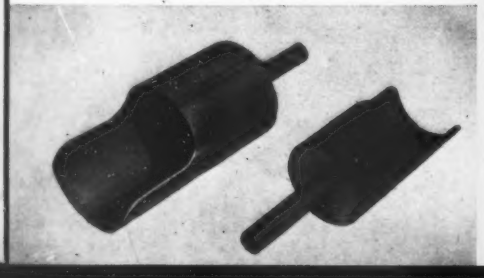


(Above) Flanges for joining units of "Pyrex" glass tubes and fittings are moulded in "Bakelite" phenolic materials for A. Jobling and Co., Ltd.

(Right) Corrosive brine used in bacon-curing by Palethorpes, Ltd., is circulated without risk of corrosion impurities through "Alkathene" extruded polythene pipes made by Tenaplas, Ltd.

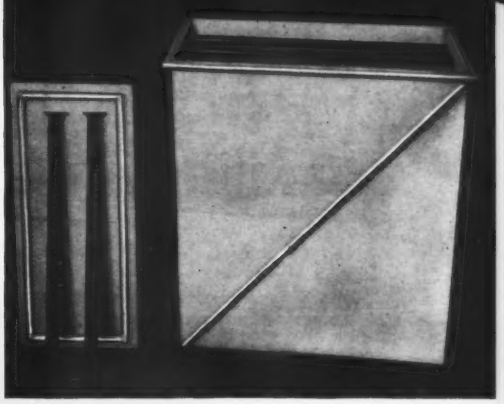


(Below) Scoops for chemicals and explosives are made from "Tufnol" because it resists corrosion and is free from the danger of sparking. (Photo: Tufnol, Ltd.)



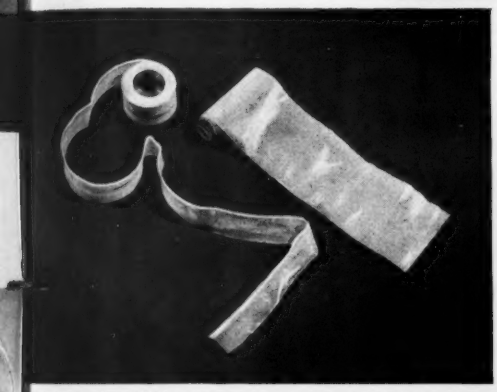
(Left) Acid-resistant polythene quart jug, injection-moulded in one piece by Airothene, Ltd., from "Alkathene," Grade 2.

(Right) Reinforced polythene trough for chromatographic analysis, with "boats" fabricated from rigid p.v.c. tubing, produced by Rediweld, Ltd.



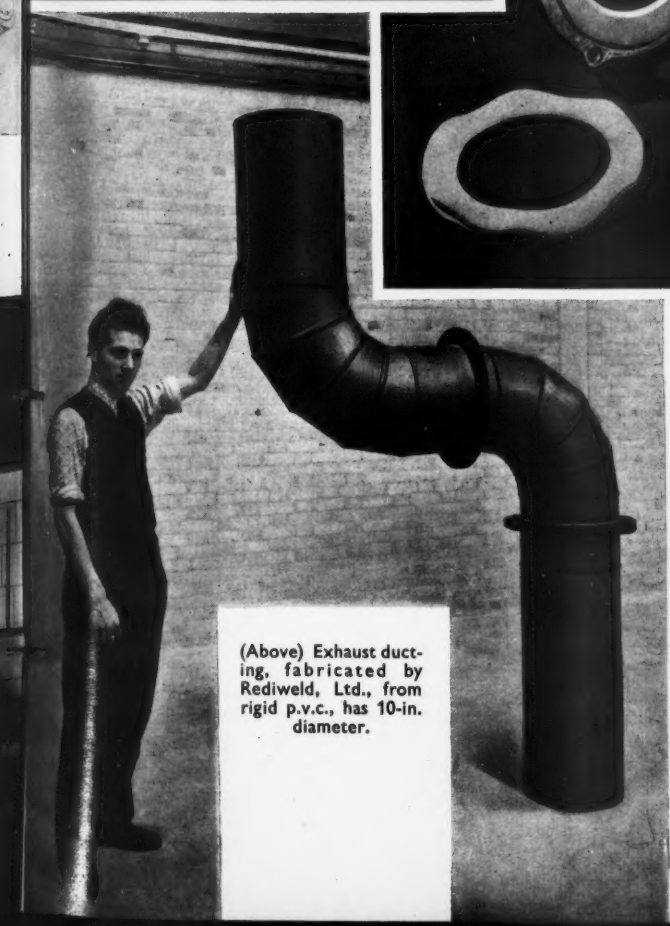
(Right and below) Chemically inert over a wide temperature range, polytetrafluorethylene is used by Crane Packings, Ltd., under the trade name of "CF2" in the form of tape or braided rings for gland packings in chemical plant.

(Below) Carrier with transparent level indicator, fabricated by Rediweld, Ltd., from rigid p.v.c.

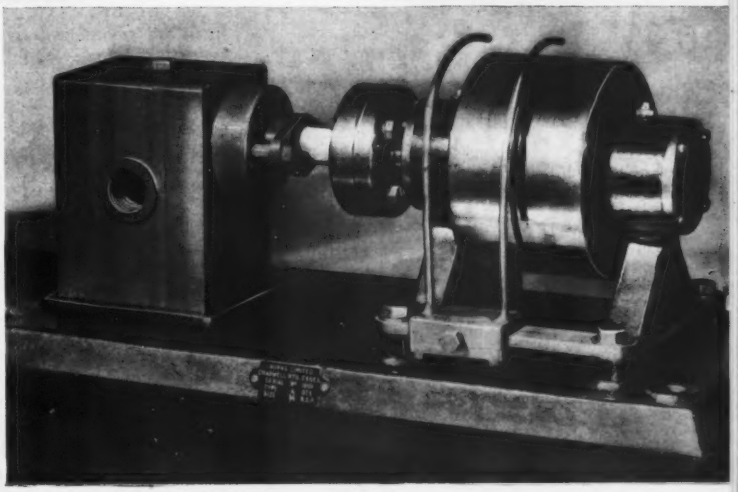


(Above) Stoppers for laboratory glassware are moulded for H. J. Elliot, Ltd., by Plastic Engineers, Ltd. They offer distinct advantages over glass and other types of stoppers.

(Left) Gasket moulded from "CF2" polytetrafluorethylene to fit the inside of an asbestos gasket, manufactured by Crane Packings, Ltd.



(Above) Exhaust ducting, fabricated by Rediweld, Ltd., from rigid p.v.c., has 10-in. diameter.



(Above) The "B.C.H." rotary gear pump, made by J. Burns, Ltd., for use with corrosive liquids, has all components made from resin-bonded fabric laminates supplied by Micanite and Insulators Co., Ltd.

Conditioning Phenolic Materials for Stability in Moulding

By JEROME L. FORMO*

Final service conditions for the moulded piece should determine the moisture content and preheat technique before moulding. This article, originally published in the Journal of the Society of Plastic Engineers, Inc., Ohio, February, 1951, is reprinted here by kind permission of the Society.

PHENOLIC moulding materials in general are subject to changes in atmospheric conditions which tend to make parts moulded of these materials change their dimensions. Consequently, the manufacture of plastic parts which will maintain close dimensional tolerances involves not only the material, its moulding techniques and geometry of the moulded item, but also a close control of a number of other factors during the life of the parts in question.

It is well known that many plastic materials change dimensions over a period of time by various mechanisms.[1, 2, 3] Included are additional polymerization or condensation with their subsequent volume decrease; loss of volatile materials, such as water, phenol, and ammonia; and loss of plasticizers, some of which are classified as non-volatile. In addition, temperature changes affect the actual dimensions of moulded parts up to 10 times as much as they affect metal parts.

Obviously, all of these mechanisms are affected by the atmosphere and operating conditions surrounding the moulded part. If, for example, a moulded part is to be exposed to a hot, dry atmosphere for a prolonged period of time, we can expect that if additional polymerization will occur, higher temperatures will cause it to occur more rapidly. Hot, dry atmosphere also will increase the rate of loss of volatile materials. If, on the other hand, a moulded part is to be exposed to hot, humid atmospheres, we know that the effect of the high humidity may be revealed in several different ways. First, it will increase the water content of the moulded part and consequently cause swelling or an increase in dimensions.[4] Secondly, condensation of water from a highly humid atmosphere on the surface of a moulded part may cause leaching of water-soluble materials with a reduction in strength and an eventual reduction in size.

Condensed water on a surface is a very good solvent for many materials which are normally not considered very soluble in water. Thus, when tests are performed with parts immersed in water, it should be understood that many materials very soon form saturated solutions. In fact, much water which is used for testing becomes saturated with certain elements or compounds very quickly and the solvent action of the water is thus decreased. However, if a continuously fresh supply of distilled water is brought to bear on a part, it will have a much more prominent solvent leaching effect on the part.

In the case of a humid atmosphere, again such materials as ammonia are taken from a moulded part and in the presence of water and heat it is very common to find that the wood flour used as a filler will decompose and produce corrosive materials, such as acetic acid.[5] In most instances it will be noted that the first source of dimensional instability in phenolic mouldings is the loss of volatiles, such as water. Thus, for example, a part which has been moulded with low moisture content will tend to reach equilibrium at a relatively low humidity, while a part moulded with a higher moisture content will become stable at a somewhat higher relative humidity.[6] To this end, a large portion of this paper is devoted to the effects of methods used to control moisture content of phenolic materials.

Other parts of the paper include studies made on volatile loss in phenolic materials during preheating and moulding cycles. Tests which were used to determine stability of moulded parts include ageing over a two-year period at high and low humidity levels, at a high-temperature level, and at controlled laboratory atmosphere conditions.

Procedure

For the portion of this work which involved measuring the effects of moisture on as-moulded conditions and on ageing effects, the following procedure was used. The test pieces were transfer moulded in a four-cavity mould at a temperature of 320 degrees plus or minus 5 degrees F. These cavities produced one 5-in. by $\frac{1}{2}$-in. by $\frac{1}{2}$-in. bar, one 4-in. by $\frac{1}{8}$-in. disc, one ASTM standard $\frac{1}{8}$-in. tensile test specimen, and one 2-in. by $\frac{1}{8}$-in. disc. Seventeen shots were moulded under each of the following conditions: 0, 20, 40, 80, and 160 drops of water per minute, dripping into the preheat oven, 180 to 230 degrees preheat (internal pill temperature), 1-min. 15-sec., 2-min. and 3-min. cure. Dry-bulb temperature in the preheat oven was maintained at 275 degrees plus or minus 5 degrees F. Transfer pressure was supplied by hydraulic pump and nitrogen bottle-type accumulator, and was controlled by a reducing valve at the press. The transfer pressure was varied for each of several conditions, so as to maintain a constant transfer time of 12 seconds. The moisture content of the preheated pills was determined in the following manner.

Samples of the preforms to be used were checked for moisture content by the Dean and Stark procedure. For each preheat condition, test preforms were heated in the oven. The change in weight during preheat was recorded as the change in moisture and used to obtain the values tabulated. Standard ASTM procedures were used in testing the flexural, tensile and Izod impact strength, insulation resistance and dielectric strength.

For the as-moulded values, five samples moulded under each of the test conditions were tested and values recorded. Three each of the remaining sets of specimens were stored under the following conditions:—

(1) 200 degrees F. oven.

(2) Laboratory atmospheric conditions —room temperature maintained at 77 degrees F., humidity varying from 30 per cent. to approximately 60 per cent. R.H.

(3) A closed container under water to approximate 100 per cent. R.H.

(4) A closed container over calcium chloride to approximate 0 per cent. R.H.

Dimensional Properties

Concerning the as-moulded physical dimensions of test pieces measured at least 24 hours after moulding, the following conclusions can be drawn:—

(1) Mould shrinkage increases as moisture content increases.

(2) Mould shrinkage decreases as preheat temperature increases.

(3) The effect of moisture on shrinkage is less pronounced in the middle range of moisture contents investigated.

(4) Mould shrinkage decreases as cure time increases.

(5) The geography of moulded pieces influences mould shrinkage.

(6) Heavy-sectioned pieces are less affected by variations in moisture content.

At a given preheat temperature, the required transfer pressure drops very rapidly as moisture increases. It appears that the pressure required for proper moulding is a relative factor which depends on the degree of preheat and the moisture content. The stiffer the material placed in the transfer chamber, the greater the transfer pressure required to

* Minneapolis-Honeywell Regulator Co., Minneapolis.

produce equivalent pressures in the mould cavities.

The dimensional values obtained from this moulding test indicate that, given a closely controlled set of moulding conditions, very small tolerances and critical dimensions of moulded parts can be maintained, at least in the as-moulded condition.

Physical Properties

(1) Flexural and impact strengths are improved by using higher preheat temperatures.

(2) Tensile and impact strengths show a slight decrease with increased moisture content.

(3) Flexural, tensile, and impact strengths all seem to show a slight improvement with increase in cure time.

Electrical Properties

(1) Insulation resistance decreases logarithmically as moisture increases.

(2) Dielectric strength decreases as moisture increases.

The curve of insulation resistance v. moisture content is nearly a straight line, making it possible to predict with some accuracy the electrical resistance of the material if the moisture content is known. Inasmuch as the shrinkage of a part is so greatly affected by the moisture content, it may be possible to measure electrical resistivity by measuring the shrinkage of the moulded piece.

Ageing Test Results

Ageing at high humidity levels for 22 months resulted in a severe increase in length of all test pieces. The results show that increased moisture content of the moulded material results in a decrease in change of dimensions under such ageing. In effect, we assume that a given general-purpose phenolic material will absorb the specified quantity of moisture and whether this occurs before or after moulding should make little difference in the total. This effect from storing at high humidity, however, indicates that for parts which are to be used in service under such conditions, it is better to use high moisture contents during the preheating operation. It may be noted also that the best stability is achieved when using a high-temperature preheating with a high moisture level in the preheating oven.

The temperature of preheating has little effect on the change in dimensions of parts aged over a long period of time. Furthermore, it seems that at room temperature a zero moisture content would give us zero change in dimensions. In other words, the only volatile of concern under drying conditions at room temperature is water. Not only is a part more subject to change in dimensions at low moisture content than at high, but also other volatiles or decomposition products are possibly involved in the mechanism of changing dimensions. Both curves seem to cross the Y axis at about .004-.005 in., indicating that something other than moisture content is accounting for about this much shrinkage.

The third phase of a study on volatiles from phenolics has been started which will attempt to show the relationship of such volatiles to dimensional stability. The effect of various moisture contents on test pieces exposed to laboratory conditions over a period of two years shows the tremendous effect of moisture which varies from season to season, as compared with the chemical shrinkage which also occurs in this type of material.

Mouldings in the middle range of moisture contents maintain the steadiest conditions throughout this period of test. Because most plastics applications result in use approximating these test conditions, it is felt highly desirable to maintain a moisture level in the moulding powder of from 1 to 2½ per cent. Furthermore, the effect of ageing at drying conditions, as well as in high-temperature conditions, shows approximately no change from the as-moulded tensile strength. There appears to be a slight lowering of tensile strength, but this is not varied with the amount of moisture present in the parts whether preheated at 180 or 230 degrees F. However, in either case after ageing at 100 per cent. relative humidity, there is a marked reduction in strength at dry preheating conditions and a less noticeable reduction of strength after moist preheating.

Ageing under either drying conditions or oven conditions results in excellent dielectric strength, while ageing under high humidity conditions results in very low dielectric strength. The important thing, however, is this, that after reaching equilibrium in the atmosphere at which a piece will be used, the dielectric strength is no longer a function of the original moisture content, but is rather affected entirely by exposure conditions, whereas in the as-moulded condition, the dielectric strength dropped off somewhat when moulded under moist conditions. This fact is of extreme importance, because it makes one question the rather broadly accepted policy of predrying material for electrical applications.

In the case of insulation resistance, it was found that all test samples aged at 0 per cent. R.H., as well as those aged at 200 degrees F., have insulation resistance values above one million megohms. Resistance of pieces aged at 100 per cent. relative humidity was reduced 4-7 megohms regardless of the amount of moisture initially present. Those aged at room conditions show variations over a considerable range reflecting to some degree the initial moisture content.

Effect of Volatiles Other Than Water

The phase of the work recorded in this section has been reported in a paper presented to the American Chemical Society by Formo and Dunbar in September, 1950. The work of the preheating volatiles determination was performed in a vacuum oven with suitable means for collecting gases given off during preheating. The oven, of 20-litre capacity, was swept at the rate of 7½ litres per minute. Supply air was cleaned of water and ammonia by bubbling through sulphuric acid. Carbon dioxide and acid fumes were removed by passing the air through an ascarite tube. Finally, the dry, clean air was heated to oven temperature by passing through a heated copper tube. The exhaust mixture of gases was bubbled through an 18-in. column of 0.2 molar sulphuric acid. The qualitative analysis indicated that, excepting water, only phenol and ammonia were evolved in more than trace quantities. Other materials, such as formaldehyde and methyl amines, which might be suspected were each checked by two methods with only negative results. Phenol was determined quantitatively by a colorimetric method.[7] Ammonia was determined by a modification of the micro-Kjeldahl technique.

Phenolic preforms were placed in the oven long enough to raise the internal temperature to 160 degrees, 180 degrees, and 210 degrees F. in the dry oven as well as in the presence of 40 to 80 drops of water per minute. The dry bulb temperature of the oven was maintained at 280 degrees F.

To measure the volatiles derived during the moulding operation, preforms conditioned in the same manner were subsequently placed in compression test bar moulds and subjected to various temperatures and cure times, holding the pressure constant at 3,000 p.s.i. in a moulding press which had means for totally enclosing the mould.

Moulding temperatures of 300 degrees, 325 degrees, and 350 degrees were used with each preheating condition, and cure times of 3, 5 and 7 minutes were used. Triplicate determinations, each the total accumulation of four individual mouldings, were used in each case.

Conclusions

(1) The only volatile products of importance to dimensional control liberated during preheating are water, phenol and ammonia.

(2) A controlled addition of moisture to a preheating oven results in:

(a) A reduction in the time required for preforms to reach a specified preheat temperature.

(b) A reduction in the quantity of phenol liberated.

(c) A reduction in the quantity of ammonia liberated.

During moulding the following generalizations may be made:

(1) Physical properties vary inversely with loss of volatiles.

(*Continued on page 82*)

Cellulose Acetate Film Protects Print

A new Danish process, introduced to this country by Celloglas Ltd., gives a decorative and protective surface to printed paper and board, by laminating a very thin cellulose acetate film to the printed matter. Fast production rates bring this method of print protection into a wider field of applications, including book covers, posters and packages.

PUBLISHERS, printers, advertising agents and display men have for some time been aware of the value of transparent plastics film for the protection and decoration of a variety of printed matter. Various methods have been developed to apply such a film and these have met with some success. All of them, however, have required either individual pressing between platens or individual clamping on of sheets.

A new process developed in Denmark and brought to this country by Celloglas Ltd., 69, Old Church Street, Chelsea, S.W.3, enables lamination to be carried out by means of adhesives as a continuous process and the faster production rates possible should considerably widen the range of uses for this type of print protection. A cellulose acetate film of 0.001 in. thickness ("Clarifoil," manufactured by British Celanese Ltd.) has been found the most suitable material for the surface layer. It can readily be bonded to printed paper with an adhesive in alcoholic solution.

Laminating Machine

The 25-ft. long machine at present in operation at the Clapham works of Celloglas Ltd., was built in Denmark. It is operated by a team of three, working under an overseer and it can easily handle reels of paper to a maximum width of 30 ins. or sheets up to quad crown size (30 in. x 40 in.). The thin "Clarifoil" film is fed into the machine in reels and one side passes over a roller which dips into the adhesive solution. While it passes over a 12 ft. rocker arm, hot air is blown on to the coated film until it is sufficiently tacky for the laminating process.

The printed matter may also be fed into the machine in the form of reels, or in sheets. Fastest production rates are obtainable when laminating film to paper in reel form since feeding-in is then continuous and automatic. Printed matter in sheet form must be fed in manually and this is necessarily slower, but presents no special difficulty. The tacky film and the printed paper are pressed together between rollers and the finished laminate emerging from the machine requires no treatment except cutting and trimming. The bond provided by the adhesive is extremely strong; attempts to separate the two layers usually result in tearing the paper.

Packaging

The ever-increasing importance of packaging in consumer goods production suggests one of the most promising fields of application. Pre-printed carton papers laminated to transparent films can be guillotined without danger of delamination and can then be assembled to make sturdy and attractive packs. Labels for tins, bottles or boxes have also been film-covered and give a more lasting, clean and attractive appearance to the pack.

Book Covers

Printers have not been slow in taking advantage of the new process and some of the work already being handled by Celloglas Ltd. indicates its wide field of applications. The protective value of the process is particularly stressed and this is borne out by the fact that one large industrial concern, British Insulated Callenders Cables Ltd., are protecting all their technical information booklets by the "Celloglas" method. Such booklets are frequently kept in factories, workshops, etc., exposed to oil and grease and handled by soiled hands. Whereas ordinary printed surfaces might soon become unrecognisable, the acetate-protected booklets may be wiped with a rag and kept permanently clean. Experiments are now being made by this and other companies for protecting wall charts and engineering drawings in the same way. Whilst the original drawing would always be kept clean and clear, alterations could readily be made since the "Clarifoil" surface can be marked both by Chinagraph marking pencils and by ball-point pens.

Book publishers, too, are taking an interest in the laminating method and our illustration shows the dust jacket for the book "Hockey" recently published by Nicholas Kaye, Ltd. Not only does the glossy film give the book a more attractive appearance, making it stand out on the shelf, but its resistance to the hard wear of frequent handling avoids any possibility of a shop-soiled effect.

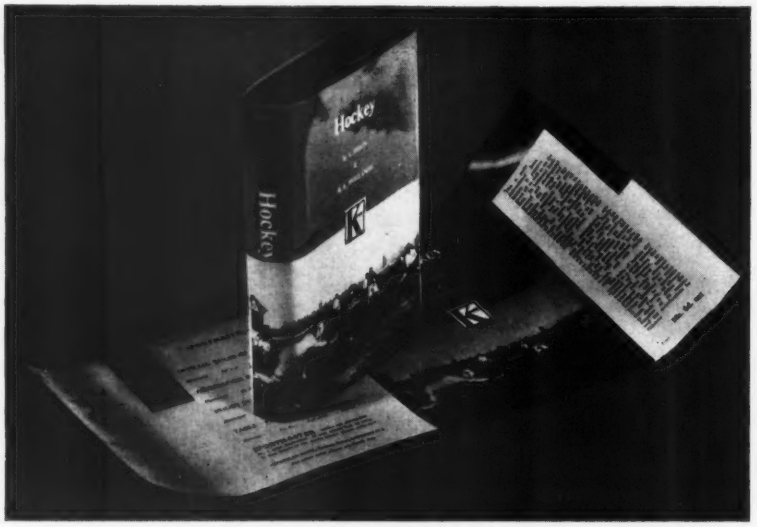
For the same reasons the "Celloglas" process could effectively be used for magazines and periodicals which are at present varnished to give a "glossy" appearance.

Display

Posters and showcards are given better appearance and longer life by the "Celloglas" process, and a series of large posters issued by the Travel Association for last year's Royal Tour of Canada was used with great success. The clarity and "depth" of the covered four-colour printing appeared even greater than the bare original.

Expanding Trade Service

At the moment, Celloglas, Ltd., are operating this process as a trade service, but it is anticipated that the demand for the whole of the country will be too great to be handled by one firm. It is the firm's intention, therefore, to sell a limited number of the laminating machines to printers and paper converters wishing to set up a trade service. These would be appointed in widely separated regional centres and royalties would probably be payable.



Dust jackets for books, treated by the "Celloglas" process, attract attention on booksellers' shelves. Ease of cleaning avoids the possibility of losses through shop-soiled stocks.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Plastics Belting

SIR,—We have been interested to read the article dealing with plastics belting for underground conveyors, which appeared in your January, 1952, issue (page 15). It will probably add to the general interest of this, if a brief description is given of the products manufactured by this company.

The culmination of years of research and trials with plastics materials as impregnants and sheathings for power transmission and conveyor belting has resulted in our production of "Fenaplast" rayon centred solid woven non-inflammable belting. As far as we are aware this was the first solid woven belt to be impregnated with a true p.v.c. latex and to have centre plies of high-tenacity rayon. The weave is quite unique, making full use of modern weaving developments and the exceptional properties of materials such as high tenacity rayons and p.v.c. products.

By a patented arrangement of the binder threads it has become possible to incorporate more warp yarn in the centre plies than is normally attainable and by a "pocketed" weave formation of the outer plies, also patented, a mechanical locking of the p.v.c. sheathing within the belt is achieved; this feature greatly assists the bond between the belt and cover under service conditions.

"Fenaplast" is made in a wide range of widths and thicknesses, and being completely sealed by the p.v.c. sheathing can be used successfully in a great number of conveyor applications where it has all the service advantages which would be expected of p.v.c. covers. A special heavy-duty-type has been developed for colliery conveyor work. This includes a number of special features designed to protect the belt against the severe service conditions which apply in this industry and in it great strength with flexibility, fire-proofness and wear resistance have been achieved.

J. H. FENNER AND CO., LTD.
Marfleet, Hull.

Rubber Printing Plates

SIR,—We are interested in obtaining a plastic moulding compound suitable for use in the manufacture of matrices for rubber stereo making.

Some time ago we experimented with a phenolic material, but it was found that this collapsed when under load in the press. The operation is carried out at a temperature of 310 degrees F. and at a steam pressure of 65 lb. per sq. in., the maximum plate size being 600 sq. ins. There are two successive drying periods of half an hour and one and a half hours.

If you are in a position to suggest where a suitable plastic compound may be obtainable, we would be most appreciative.

M.B.T.

"Tailor-made" Plastics Covers

SIR,—We note that you frequently publish inquiries from people requiring specially made p.v.c. covers. You may care to record our name for future reference as manufacturers of "tailor-made" p.v.c. pockets, bags, covers, etc., for specialized packaging of anything from soft goods to machinery; also the electronic welding of p.v.c. sheetings.

BLUE STAR PLASTIC PRODUCTS, LTD.
Victoria House,
Bath Lane, Newcastle upon Tyne, 1.

P.V.C. Wallets

SIR,—We would be obliged if you would let us have the addresses of half a dozen manufacturers of wallets, note-cases, document cases, key cases, etc., made from p.v.c. material, for which we have a major export inquiry.

LESMAR, LTD.
The Burroughs House,
The Burroughs, Hendon, N.W.4.

[EDITOR'S NOTE: H.F. welded p.v.c. goods of the type our correspondent inquires for are made by Cascelloid, Ltd., Abbey Lane, Leicester; Brainos, Ltd., 225, Southwark Bridge Road, London, S.E.1; A. J. Siris Products, Ltd., Lanchester, Co. Durham; H. and P. Polak, Ltd., 26, Canon Street, Manchester, 4; John Tye, Ltd., Caledonian Road, London, N.7; Acme Plastics, Ltd., 11-13, Goldsmith Row, London, E.2.]

Polythene Lay-flat Tube

SIR,—We notice in the February issue of "Plastics" a letter inquiring for polythene lay-flat tube.

In your note you mention that polythene lay-flat tube is supplied by Cascelloid, Ltd., Abbey Lane, Leicester. In actual fact our associate company only market polythene bags, whilst polythene lay-flat tube is supplied by us.

BX PLASTICS, LTD.
Higham Station Avenue,
Chingford, E.4.

Polythene Bags

SIR,—We note that inquiries have recently been made to you for a supply of polythene bags. We would very much like to draw your attention to our activities in the polythene conversion field, which are many and varied, amongst which we can include the manufacture of polythene bags, both lay-flat and gusseted, printed or plain.

OPPENHEIMER CASING CO. (U.K.), LTD.
Rival Packaging Division,
159-165, Harrow Road, W.2.

Hot-plates and Platens

SIR,—We are interested in purchasing platens 7 ins. or 8 ins. square or circular, and approximately 1½ ins. thick, giving a temperature of 90 degrees C., with or without built-in thermostat.

LIGHT STEEL SECTIONAL CONSTRUCTIONS, LTD.
Commerce Way,
Lancing, Sussex.

Acid-resistant Sealing Medium

SIR,—We have seen a long letter published in your February issue from "Enquirer." We think that our "Nutracote" p.v.c.-based coating may be the answer to your correspondent's problem.

TANKS AND LININGS, LTD.
Town Wharf,
Droitwich, Worcs.

Producing Small Models

SIR,—We are seeking information on a method of producing small quantities of models in a thermoplastic material. This technique is practised, we understand, in the U.S.A., and involves making a treated plaster-of-paris mould around a model corrected dimensionally for shrinkage errors, etc.

Can you recommend any firms undertaking such model-making commercially?

ENGLISH ELECTRIC CO., LTD.
F. Bradbury,
Chief draughtsman Instrument D.O.,
Stafford.

Acid-resistant Sealing Medium

SIR,—We notice in the February, 1952, issue of "Plastics" (page 47) that one of our correspondents has a problem in sealing an orifice in a nickel and chromium plated steel tube.

We wish to draw the attention to our polyvinyl chloride self-adhesive tape, under the trade name "Lassoric," which is supplied to the electroplating industry for masking purposes. We have developed a special adhesive on this p.v.c. base to withstand the attack of acids as experienced in plating processes. We feel that this "Lassoric" tape would be a solution to your correspondent's problem.

HERTS PHARMACEUTICALS LTD.
Lasso Products Section.
Bessemer Road,
Welwyn Garden City, Herts.

Scoops

SIR,—We are seeking a source of supply for small plastic scoops of spoon-shape measuring 1⅛-in. by ¾-in.

J. AND L. RANDALL, LTD.
Merit House,
Cranborne Road,
Potters Bar, Middlesex.

New Productions

Standard Coffee Measure

The Coffee Buyer's Association, 121, Cannon Street, London, E.C.4, has produced a standard coffee measure "in the interest of better coffee." The measuring cup, which has instructions moulded in relief, is injection-moulded from polystyrene moulding material supplied by Erinoid Ltd. The mouldings are produced by the Plastics Division of Mentmore Manufacturing Co., Ltd., 1, Bradley Road, London, N.22.

Car Registration Plates

Flexible letters and numerals, intended primarily for assembling into car registration number plates, have been introduced by Hills Number Plate Service, Chenies Mews, London, W.C.1. The individual pieces are injection moulded in white polythene. They are mounted on the plates by means of lugs (which are moulded on the back of each piece) and the use of patented aluminium washers with jaws which clamp upon the polythene makes removal impossible once the assembly is complete. The well-known properties of the polythene not only provide an unbreakable numeral, but also facilitate fixing to uneven or curved surfaces. It has been suggested that these letters and numerals should find various applications other than those originally intended.

Name Sign for London Store

An opaque "Cinemoid" wire-weld facia fitted with flush green-tinted "Cinemoid" wire-weld letters 4 ft. 9 ins. high, edged with narrow bronzed T-section aluminium extruded band, recently erected at sixth-floor level at the London store of D. H. Evans and Co., Ltd., Oxford Street, W.1, illustrates one of the lesser-known uses of the non-inflammable cellulose acetate sheeting made by British Celanese, Ltd., and supplied under the name "Cinemoid." Shadowless illumination is provided by fluorescent tubes. Similar signs have also been installed at other floor levels and above the main entrance to the store. The signs were made by J. Starkie Gardner, Ltd., artist-craftsmen, Merton Road, Southfields, London, S.W.18.

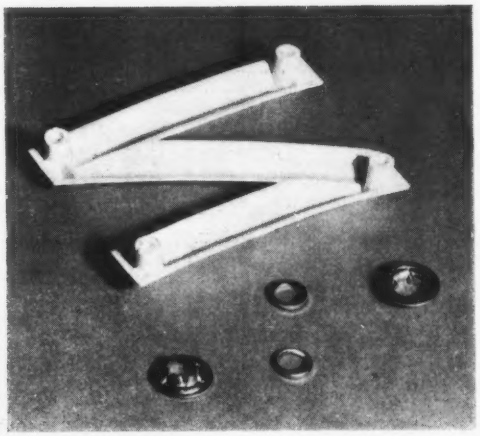
Display Stand

The simple display unit for packed coffee seen in one of our illustrations shows the package to fullest advantage. It will be noticed how all unnecessary moulding has been avoided; the top row of tins rest on those beneath, and the back of the stand is moulded to display them tilted slightly backwards. Careful design in this connection must have effected a considerable saving in moulding costs. The lettering is silk-screen printed in green by the moulders, British Artid Plastics, Ltd., 361, Buckingham Avenue, Trading Estate, Slough; the stand is moulded in I.C.I. wood-filled urea, of cream colour.

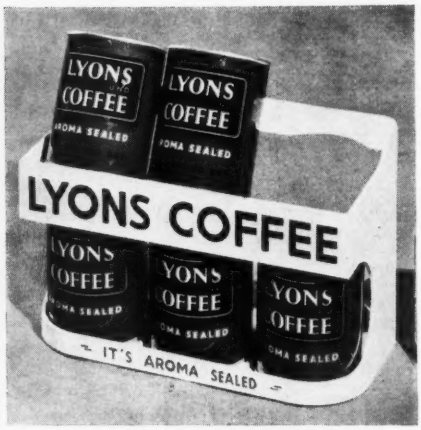
Safety Grater

We are informed by Injection Moulders, Ltd., that the "Linda" safety grater illustrated in "Plastics," January, 1952 (page 20), is moulded in polystyrene, and not cellulose acetate.

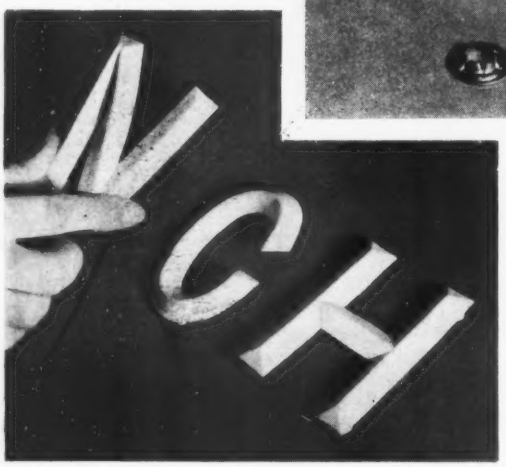
(Above) Standard coffee measure.



(Below and right) Flexible letters for car registration plates.



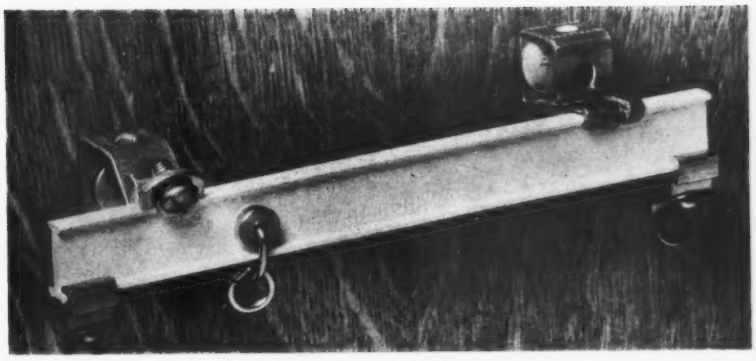
(Above) Display stand.



(Right) Name sign for London store.

Curtain Runway

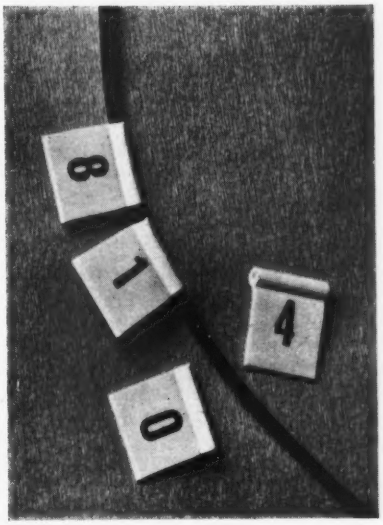
One of the photographs on this page shows some curtain runway, extruded in hard p.v.c., which has recently been introduced in the "Rufflette" range of curtain fittings by Thomas French and Sons, Ltd., Manchester. We are told that it has not been produced on account of shortage in metal supplies, but is the result of definite research to provide certain new features. With care in handling, this new plastics runway can be bent to almost any shape, but because of its intentional flexibility a greater number of support brackets have to be used than are needed for metal runway. The plastics product is only one-fifth of the weight of a similar manufacture in brass. It has the advantage of being unaffected by acid or alkali, and lengthy tests at arctic and tropical temperatures have proved that it is suitable for use under these conditions.



Curtain runway (extruded hard p.v.c.).

Markers for Wires and Cables

Hellermann Electric, Ltd., Crawley, Sussex, have just introduced a new system for identifying small wires in any complicated electric wiring installation or cables. These flag markers are made from polyvinyl chloride and are fitted under tension. They provide a large surface to receive the markings, can be fitted to wires as small as 1/32-in. outside diameter, and are supplied in any size to suit the user's requirements.

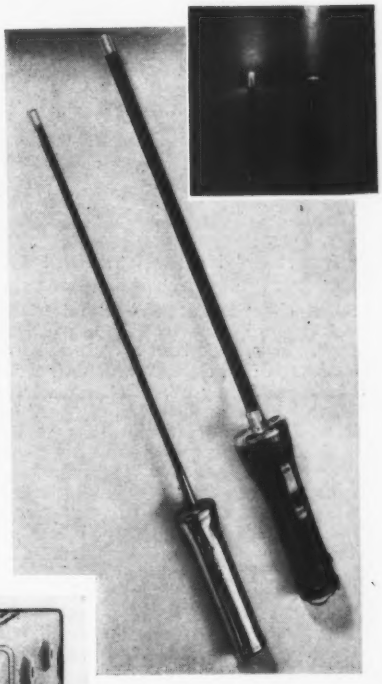


Electric wire markers (p.v.c.).

Probe Illuminators

The optical properties of methyl methacrylate resins, especially their ability to "pipe" light through long rods and round corners, have already been used successfully in dental and surgical instruments. In engineering practice, the need to provide good illumination for inaccessible parts of machinery is equally important, and Engineering Developments (England), Ltd., 50, Pall Mall, London, S.W.1, have now introduced a series of probe illuminators working on a similar principle.

The two instruments at present in production are in essence battery-operated electric torches fitted with bulb caps holding "Perspex" rods. The smaller model (EDM 401) has a metal case holding two U.2-type cells. The 18-in. probe made of ¼-in. "Perspex" rod is covered with black p.v.c. to absorb stray reflections, as well as to give mechanical erection to the polished surface of the rod. Due to its small diameter, the probe rod retains considerable flexibility, making the instrument particularly suitable for inspecting pipes, tubes, etc. The second model (EDM 402) is of more robust construction with a shock-proof rubber holder and a "Perspex" probe ½-in. diameter, also sheathed in black p.v.c. It is used for the examination of machinery through small inspection holes, and for such matters as aircraft refuelling at night, where overflowing is dangerous.

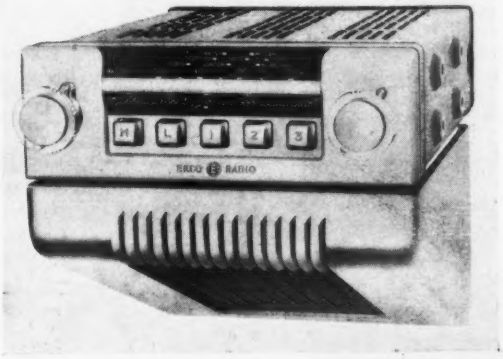


(Above) Probe illuminators ("Perspex").

(Below) Midget torch (cellulose acetate).

Midget Torch

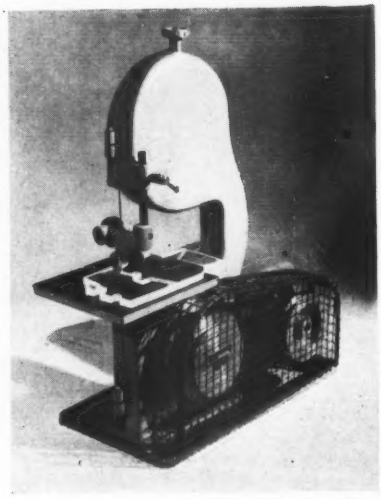
The small "Spot Lock" torch, less than three inches long and easily carried in a lady's handbag, should save much trouble in looking for keyholes or finding small objects in the recesses of the handbag. The housing consists of three injection-mouldings in cellulose acetate—an opaque battery housing, a push button switch, and a white translucent bulb cap. The push-button is pierced to take a small chain which can be used as a key chain. The torch, including the mouldings, is made by Plastomatic Ltd., 17 Winchester Road, London, N.W, and is sold by them, both at home and for export.



(Above) "Ekco" car radio (E. K. Cole, Ltd.), has a plastic escutcheon surrounding a dazzle-free, edge-lit tuning scale, with a new three-position light-dimming control. It can be fitted into spaces of varying shape and dimensions.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

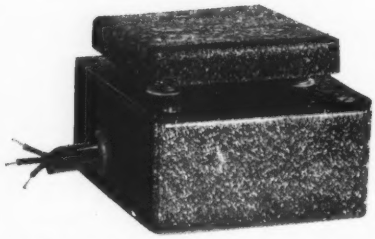


"Tyler Minor" bandsaw (Spiral Saws Ltd).

SAWING "PERSPEX."—Spiral Saws, Ltd., Bedford Avenue, Trading Estate, Slough, Bucks, have been experimenting on the cutting of "Perspex" with their spiral blade bandsaw. By using water as a lubricant, they have found that a very good cut can be obtained on thick sheets of this material, as specimens sent to us for inspection readily confirm. The bandsaw referred to was illustrated in "Plastics," September, 1950 (page 256). This machine provides for selective speeds of 70 to 5,000 feet per minute, and special rubber-tyred guide rollers ensure a rigid cutting line. The saw blade is of spiral tempered steel wire in spiral form, and is therefore able to cut profiles which would present difficulties to the conventional form of hack-saw blade. Spiral Saws, Ltd., also make the "Tyler Minor" 7-in. bandsaw, driven by a ¼ h.p. motor with built-in switch, which gives three speed variations by means of a multi-groove V-pulley.

MACHINERY EXPORT LICENSING.—Changes in export licensing control, which came into operation on February 4, 1952, show that licences are now required for certain types of rubber and plastics working machinery. According to the Board of Trade the machinery affected includes callenders with three or more rolls, with rollers of a width of 60 ins. or over; roll mills with rollers of a width of 60 ins. or over; batch mixers or masticators, enclosed or semi-enclosed, having a chamber capacity of 4½ cubic ft. or more; tyre-curing presses, single or multiple cavity, capable of accommodating tyre moulds of a total outside depth of 10 ins. or more; and extrusion, injection and other moulding machines.

ELECTRONIC TIMERS.—Allied Electronics, Ltd., 28, Upper Richmond Road, Putney, S.W.15, have sent us a set of leaflets describing the range of electronic timers which they have recently introduced. These timers are very suitable for controlling the process time of moulding presses and can be supplied in a form suitable for incorporation in the machines. Industrial timer Model 148A has a timing range up to 110 seconds in one-second steps. The circuit is compensated for wide variations in mains frequency and voltage, and repetition accuracy is better than plus or minus 0.25 per cent. Model 148E is useful in cases where a closely graduated time scale is not required; it gives nine time intervals between 0.25 and 64 seconds. This company also make a robust foot switch for use in conjunction with their electronic process control equipment. The use of this switch frees the operator's hands for other uses.



Foot switch for electronic control equipment (Allied Electronics Ltd.)

SCREENING CLOTH.—A new British Standard for textile screening cloth (B.S. 1812 of 1951) has been published. In the past it has been common practice to base ranges of sieves and screening cloths on the number of meshes per inch. The British Standard, however, is based on aperture sizes. A single series of aperture sizes is specified, ranging from 50 microns to 1,600 microns, i.e., from 0.00197 in. to 0.0630 in. It applies to each of three weights of cloth which may be made. This will enable the user to select the appropriate aperture for his purpose and then quite independently to choose the most suitable of the weights of cloth specified. Each cloth should be known by its nominal aperture in microns and according to its weight as light, medium and heavy. The range of aperture widths is based on a uniform series of 6 per cent. increments from one cloth to the next.

CENSUS OF PRODUCTION, 1952.—The Census of Production to be taken in 1953, in respect of the year 1952, is to be simplified. Forms will contain fewer questions than in any previous census and "sampling" will be introduced for the first time. The census will cover all producing industries as before and returns will be required from all firms over a certain size in each trade. A "sample" will be taken of smaller firms, which means that the majority will not be required to make a return. The information obtained from the "sample" will permit early estimates to be made of certain important aggregates such as total sales, materials used, stocks, and capital expenditure for each trade.

The statutory form of return will include questions on (1) working proprietors, (2) average employment during the year, (3) wages and salaries, (4) plant, machinery and vehicles, (5) new building work, (6) total materials and fuel purchased, (7) work given out, (8) stocks at the beginning and end of the year, (9) total output, and (10) transport payments.

Any firm requiring further particulars should write to the Census of Production Office, Neville House, Page Street, London, S.W.1.

PATENT OFFICE LIBRARY.—It has been decided to continue the extended hours of opening of the Patent Office Library, Southampton Buildings, Chancery Lane, W.C.2. The hours are 10 a.m. to 9 p.m. Monday to Friday, and 10 a.m. to 5 p.m. Saturday. These extended hours of opening were first introduced on May 7, 1951.

NEW COMPANY REGISTRATIONS.—The analysis of new company registrations, compiled from official sources by Jordan and Sons, Ltd., company registration agents, 116, Chancery Lane, London, W.C.2, shows that during the period January 1 to December 31, 1951, there were registered in England and Wales 61 private companies classed as "plastics," with a total capital of £249,700; included in this total was one company with a capital of £100,000. Among public companies there were no registrations classed as "plastics."

DESIGN AND PRODUCTIVITY.—A British specialist team, under the auspices of the Anglo-American Council on Productivity, sailed for the United States early in February to study what is being done in America in the field of industrial design. The team will make a study in the engineering and allied industries of how design can be integrated with production to ensure the best utilization of available materials. It will also examine methods for securing effective co-operation between research, design, development and engineering departments. Special attention will be paid to simplification of procedures, reduction of scrap, and cutting of costs in relation to quality and customer requirements.

PACKAGING.—The 4th Educational Course of Packaging organized by the Institute of Packaging, has been postponed until May. It had already been scheduled for March, but will now be held May 19-23, inclusive, at Shell-Mex House, Strand, W.C.2.

PLASTICS IN SPAIN.—The Plastics Department of the Patronate "Juan de la Cierva," in collaboration with Spanish manufacturers, is organizing a First National Meeting of Plastics, to be held in Madrid, May 12-15, 1952. At this meeting several distinguished foreign experts, and Spanish specialists and technicians, will deliver lectures of interest to the plastics industry, and discussions will be arranged on "Standardization and Control," "Raw Materials" and "Professional Training." The first Exhibition of Plastic Materials in Spain will be held concurrently. Further details can be obtained from Organizing Committee, First National Meeting of Plastics, Serrano, 119, Madrid (Spain).

KEY INDUSTRIES DUTY.—The Treasury have made an Order under the Finance Act, 1926, removing the following products from exemption, as from February 20. 1952: Cellulose acetate, where the weight of the acetyl content, calculated as acetic acid, is less than 60 per cent. but not less than 55½ per cent. of the weight of the cellulose acetate, not being cellulose acetate which is an ingredient or forms part of a composite article; dibutyl diethylmalonate,

dibutyl phthalate, dioctyl phthalate. Artificial silk waste, which consists wholly of cellulose acetate or is dutiable only by reason of containing cellulose acetate as an ingredient, continues to be exempted from Key Industries Duty until August 18, 1952.

ACETONE.—The exemption of acetone from Additional Import Duties under the 1932 Act continues until August 18, 1952.

MONSANTO POLYSTYRENE—"Lustrex," which is a substantially pure form of polystyrene plasticized by heat alone, and made specifically for injection moulding, is the subject of a brochure published by Monsanto Chemicals, Ltd., Victoria Station House, London, S.W.1. Its characteristics in strength, colour, dimensional stability, optical clarity, lightness, chemical resistance and thermal qualities are all emphasized. Unlike most other plastics, "Lustrex" actually gains in tensile strength and general toughness as temperature decreases. Its low thermal conductivity (K factor, 1.9) makes it an excellent insulating material. It may be used in shredded form for this purpose and is also used in moulded form for the making of refrigerator breaker strips. Electrical insulation is also excellent; coaxial cable spacers, coil formers, stand-off insulators, socket bases, high-tension lead-ins and non-spill storage batteries are typical applications.

PLASTICIZERS.—Shell Chemicals, Ltd., 105-109, Strand, London, W.C.2, have sent us a copy of their recently published booklet on "Alphanol" 79 and "Nonanol," which are alcohols of medium chain length finding use in the manufacture of plasticizers. There are over 14 pages of useful information, including tables and charts, relating specially to the use of these materials as plasticizers for p.v.c. A brief note deals with the higher alkyl acrylate and methacrylate polymers as lubricating oil additives, and in textile finishing, leather processing, and the manufacture of leathercloth and waterproof papers. Test methods for p.v.c. compositions are tabulated in an Appendix.

TYPKE AND KING, LTD., a division of Durham Chemicals, Ltd., have issued leaflets dealing with Notacks in rubber and plastics technology. These are aqueous pastes or powders for solution in water which neutralize the surface tackiness of rubber and plastic extrusions, etc.; they are also excellent steel mould lubricants, greatly facilitating removal of rubber and plastic mouldings from the mould.

PLASTICS FOR AIRCRAFT.—Aircraft material specification of the Ministry of Supply, D.T.D. 845, recently reprinted, relates to polymethyl methacrylate sheets, panels and shapings, Grade B. It includes methods for the determination of transparency, freedom from visual distortion, tensile strength and resistance to accelerated ageing, and also a general method of examination for defects. The material covered by the specification is described as a stable polymer of methyl methacrylate plasticized with a 5 per cent., plus or minus ½ per cent., dibutyl phthalate. The dimensions of sheet material shall not exceed 72 ins by 48 ins., with a tensile strength not less than 7,000 lb. per sq. in., and mean thickness not differing from specified thickness by more than 5 per cent. Unacceptable defects include (i) fibres larger than 5 mm.; (ii) foreign matter larger than 1.5 sq. mm. (iii) surface faults larger than 3 sq. mm.; and (iv) scratches which cannot reasonably be polished out. Defects within 4 ins. of the edges of uncut sheets are disregarded.

BOWTHORPE HOLDINGS, LTD.—On February 19, Mr. W. Puckey, Deputy Controller of Supplies, Ministry of Supply, performed the opening ceremony of the new Bowthorpe-Hellermann Administrative Block at Crawley, Sussex, in the presence of a great number of industrial friends of the constituent companies. The latter comprise Bowthorpe Electric Co., Ltd., Hellermann Electric, Ltd., and Bowthorpe Engineering Co., Ltd. The visitors were shown round the various works, which included the Hellermann cable marker and sleeve shops, the engineering shops, tool rooms and the plastics manufacturing unit where injection mouldings, low-pressure mouldings, dippings and glove coatings are produced.

BAKELITE, LTD., and their associated company, Warerite, Ltd., announce that their Northern Sales Office has now moved to more spacious quarters at the Royal Exchange, Manchester, 2 (telephone: Blackfriars 5174-7).

REX BOUSFIELD, LTD., 84, St. Paul's Churchyard, London, E.C.4, merchants for builder's constructional materials, including "Formica," "Holoplast," "Weyroc," "Perspex" and "Perspex" roofing lights, announce that Mr. Peter G. Bousfield and Miss P. Joan Bousfield have been appointed directors.

H. L. PIGNON, LTD., Bryantwood Road, N.7, and associated companies Pignon Plastics, Ltd., and Pignon and Roberts, Ltd., held a dinner and dance for the management and staff on February 9. This marked the 30th anniversary of the founding of the group by the present chairman, Mr. H. L. Pignon.

TELEGRAPH CONSTRUCTION AND MAINTENANCE CO., LTD.—Dr. Esmond Wassell Smith, Ph.D., B.Sc., M.I.E.E., has been appointed to the Board to fill the vacancy caused by the retirement of Lord Riverdale. Dr. Smith is one of the leading authorities on world submarine telegraph and telephone cables, and has been with the Telcon organization for 42 years, latterly as manager responsible for producing some 3,500 nautical miles of submarine cable a year. He was with the expedition to Newfoundland which laid the first duplex loaded cable in 1928. It was this research work which provided him with the material for the thesis which gained for him the degree of Ph.D., University of London. In 1929 he went to Teneriffe in conjunction with research on coaxial telephone cables.

E. K. COLE, LTD., announce the appointment of two new representatives to their Plastics Division—Mr. P. W. Orme, technical sales representative, has been a member of the Plastics Buying and Commercial Departments of Ekco; Mr. A. E. Males will deal with sales of sanitary ware.

MR. G. HAIM, general manager of Rediweld, Ltd., Crawley, Sussex, is at present on a business trip to the United States and Canada, visiting customers and investigating new developments.

MR. ANDREW REID.—The British Plastics Federation has appointed Mr. Andrew Reid as publicity officer. Mr. Reid was Press officer of the British Plastics Exhibition held at Olympia in London last year, and previously he acted for the Federation on the occasion of the announcement of their Certification Mark. For six years he was Press officer of the British Industries Fair.

MR. C. C. LAST.—Bakelite Ltd. recently gave a luncheon to celebrate Mr. Last's 25th anniversary with the company. Mr. Last, who was presented with a gold watch, joined Bakelite Ltd. on February 1, 1927. He was appointed sales manager for moulding materials in 1931, became general distribution manager in 1941, general manager in September, 1948, and a director of the company in July, 1951. He is the Founder President of the Plastics Institute; founder and chairman of the Plastics Industry Golfing Society; chairman of the British Plastics Federation Plastics Material Manufacturers Group and also of the Moulding Powder Section; a member of the British Plastics Federation Executive and Council; and for fifteen years, until recently, was chairman of the Publicity Committee.

The team chosen by the Moulders Group of the British Plastics Federation to visit the United States under the auspices of the Anglo-American Council on Productivity (see "Plastics," February 1952, page 50) sailed from Southampton in the "Queen Elizabeth" on February 12. Our photograph shows members of the team at Waterloo Station, with Dr. W. E. de B. Diamond, director of the British Plastics Federation (on right), shaking hands with Mr. A. L. Sparshott, leader of the team.

Machines for the Industry

Manesty RS2 Rotary Tablet Machine

The "RS2" tablet machine described in this article is made by Manesty Machines Ltd., Speke, Liverpool 19. Moulding powder preforms can be produced at rates up to 326 tablets per minute on this machine.

THE Manesty "RS2" tablet machine is a rotary machine ideally suitable for producing preforms over a wide range for the plastics industry. Designed with a turret (1) carrying 21 sets of punches (2) and dies (3), this machine is capable of producing large-size tablets (1⅜-in. dia. max.) at a high rate of output (163-326 per min.) and a maximum pressure of 12 tons.

The machine (Fig. 1) consists primarily of a cabinet (4), column (5), turret (1), worm housing (6), and upper roll housing (7). The drive is from a 5 h.p. 1,420 r.p.m. motor (8) mounted on the side of the cabinet, then from a 2/1 ratio variable-speed pulley (9) on to the driving pulley (10) mounted into the worm housing (6). The motor is mounted on an adjustable base (11) which provides adjustment both for belt tension and speed change, this operation being carried out by the handwheel (12) mounted on the front of the cabinet. The driving pulley (10) is mounted on its own bearing, and incorporates the flywheel, the drive being taken by a friction clutch (13) thus enabling the motor to be running at full speed under minimum load before the clutch is engaged. The whole of this unit is mounted in an easily removed housing (14) at the rear of the machine, the clutch being operated by the lever (15). The wormshaft is mounted on anti-friction bearings of ample size to take the journal and thrust loads. The worm (16) is of nickel steel, case-hardened and ground on the threads. It conforms to British Standards specification and runs in an oil bath. A hand motion to the wormshaft is provided to enable the turret to be revolved by hand when inserting the punches; this is obtained from the handwheel (17) on the front end of the worm housing. This handwheel does not revolve when the machine is running under power. The complete worm housing (6) is adjustable to enable the backlash between the worm and wheel to be maintained at a minimum. The turret (1) is mounted on the column (5) and carries the wormwheel (18); this wormwheel is of Holfos bronze and is accurately machined and cut to British Standards specification. As the whole of this drive is enclosed very little attention apart from maintaining the oil level (19) is necessary.

The turret (1) carries 21 sets of punches and dies, and is accurately machined to ensure lineability of the upper- and lower punches. Thus dies are securely held in position by locking screws which prevent them from lifting, or, in the event of shaped punches being used, from turning. The lubrication to the turret column (5) and the lower punches is by wick feed from a reservoir in the upper cam track (20) for which a dipstick (46) is provided at the top of the upper roll housing. No lubrication is provided to the upper punches as it has been found that lubricating the punches by hand on assembly is usually sufficient. The cams (21, 22, 23 (Fig. 2) for the lower punches are mounted on the base

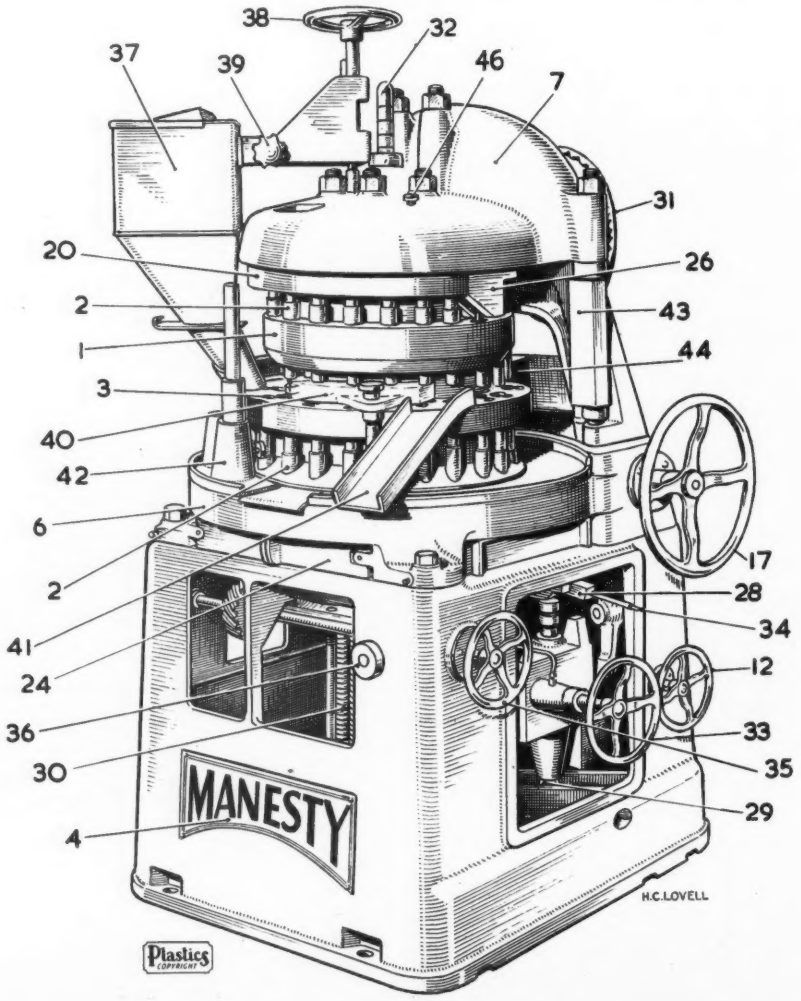


Fig. 1. — The Manesty RS2 rotary tablet-making machine.

1.—Turret. 2.—Punches. 3.—Dies. 4.—Machine cabinet. 6.—Housing for worm and wormwheel. 7.—Upper roll housing. 12.—Motor adjusting handwheel. 17.—Turret-rotating handwheel. 20.—Upper cam track. 24.—Doors opening to lower punch cams. 26.—Cam for upper punches. 28.—Lower roll carrier. 29.—Lever mechanism. 30.—Roll carrier support springs. 31.—Lower roll adjustment handwheel. 32.—Indicator shaft. 33.—Tablet thickness adjustment handwheel. 34.—Thickness pre-setting indicator. 35.—Filling adjustment handwheel. 36.—Depth of fill indicator. 37.—Hopper. 38, 39.—Hopper adjustment handwheels. 40.—Feed frame. 41.—Tablet chute. 42, 43.—Hinges for "Perspex" guards. 44.—Dust exhaust. 45.—Upper roll. 46.—Dipstick.

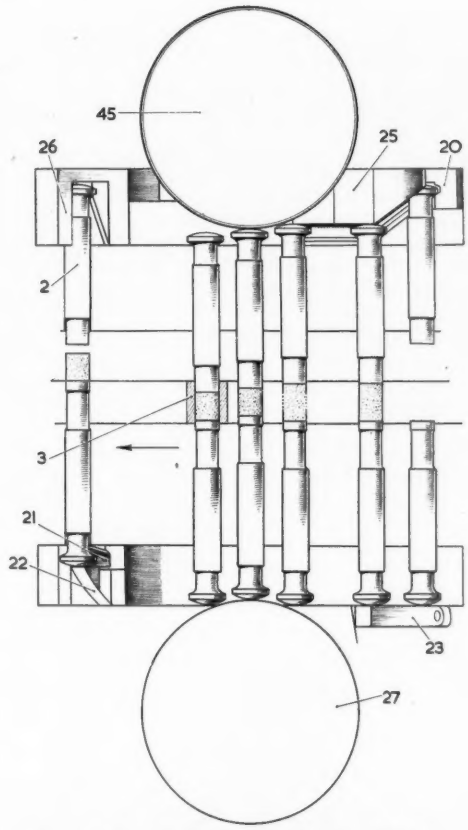


Fig. 2.—Diagram indicating mechanism of tablet compression.

2.—Punches. 3.—Dies. 20.—Upper cam track. 21, 22, 23.—Cams for lower punches. 25, 26.—Cams for upper punches. 27.—Lower roll. 45.—Upper roll.

of the column (5) and are easily accessible through the hinged doors (24) mounted on the worm housing. The cams (25 and 26) for the upper punches, being mounted on the top of the column, are also easily accessible for inspection. The lower roll (27) is mounted on a carrier (28) which is fulcrumed in the cabinet; this carrier is supported through a lever mechanism (29) by four springs (30) which pass up the inside of the column. The mechanism provides an overload release to the lower roll in the event of a foreign body getting into the die, or a double-fill occurring, thus giving full protection against excessive pressures to the punches and to the machine. The control of this mechanism is obtained from the handwheel (31) on the side of the upper roll housing (7). This handwheel adjusts the springs (30) and applies a resistance to the lower roll carrier; an indicator shaft (32) shows the amount of this resistance, which when fully adjusted will be equal to 12 tons between the two punches. Thus when this figure is exceeded, the lower roll will retract until the load assumes normal again. An independent adjustment is provided to the lower roll for setting the thickness of tablet produced. This is obtained by the handwheel (33) and an indicator (34) shows the setting on a graduated plate. All the bearings of this lever mechanism are mounted on self-oiling bushes. A handwheel (35) provides the adjustment for the depth of fill or weight adjustment; this lifts or lowers the adjustable wedge (23) according to the requirements, and a minimum fill of $\frac{1}{4}$ in. can be obtained or a maximum fill of 2 ins. These fills with material of, say, 2/1 compression ratio would produce tablets $\frac{1}{8}$-in. or 1-in. thick respectively, these thicknesses being preset on the indicator (34) by handwheel (33). For reading the depth of fill, a graduated dial (36) is

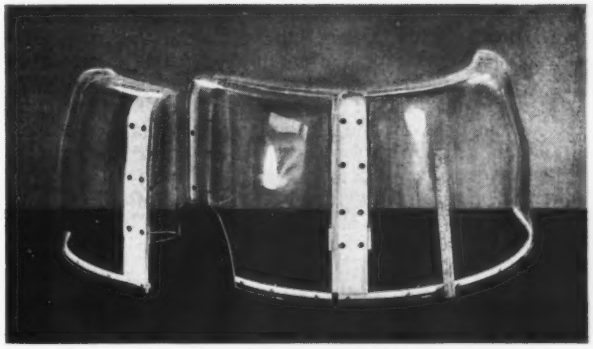


Fig. 3.—Transparent "Perspex" guards for the Manesty tablet machine are hinged at points 42 and 43 (Fig. 1). The guards are made by Rochdale Plastic Co.

mounted conveniently close to handwheel (35). This dial reads between $\frac{1}{4}$ in. and 2 ins. The hopper (37) is mounted on top of the upper roll housing and is adjustable both vertically and horizontally by means of the handwheels (38 and 39) respectively. The powder feeds into the turret and passes right round to the front of the feed frame (40), This method ensures that the dies begin to fill immediately the tablet has been scraped off the turret and on to the chute (41). This type of hopper is most efficient when the material is in granular form. For material of a fine and fluffy texture, an elevator feed unit is manufactured to run in conjunction with the machine. This feed unit is much better than the orthodox type of hopper, as the tendency to pack the material and thus restrict the flow to the machine is minimized, and it is also much easier to keep it charged with an adequate supply of material.

When required, core rods can be fitted to the punches, providing this is requested when the machine is ordered. This enables tablets to be produced with centre holes in them up to a maximum of $\frac{3}{4}$-in. diameter.

The revolving turret is completely enclosed by moulded "Perspex" guards, suitably hinged (42 and 43), and at the pressure point of the upper and lower rolls a dust exhaust nozzle (44) is provided to be connected to the main exhaust

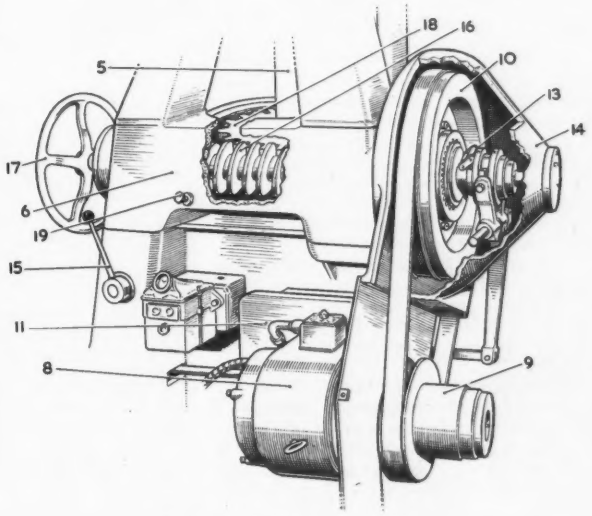


Fig. 4.—Details of drive mechanism.

5.—Turret column. 6.—Housing for worm and wormwheel. 8.—Motor. 9.—Variable speed pulley. 10.—Driving pulley. 11.—Adjustable motor base. 13.—Friction clutch. 14.—Drive housing. 15.—Clutch lever. 16.—Worm. 17.—Turret-rotating handwheel. 18.—Wormwheel. 19.—Oil level control.

system of the department in which the machine is situated.

The "start" and "stop" pushbutton for the machine is situated in the cover on the front of the machine, conveniently placed at the normal operating position.

After the punches and dies have been fitted, the feed frame set back in position, and the hopper charged with material, the weight adjustment should be set by the handwheel (35) to the required depth of fill, as indicated on dial (36). The lower roll position must then be set by handwheel (33) and shown by indicator (34). This setting will be somewhat governed by the compression ratio of the material being used. Adjust the handwheel (31) to apply the load which it is presumed will be required, and start up the machine first by the pushbutton, and when the motor has reached maximum speed, engage the clutch. Observe the lower roll position indicator (34) and if this is being depressed when the tablet is being formed, adjust the load by turning the handwheel (31) until the deflection of the indicator is just perceptible. Critical adjustment of this mechanism, in conjunction with adjustments to the weight adjustment and tablet thickness, will produce satisfactory tablets and give relief to the slightest excess pressure.

The cycle of operation of the punches is controlled by the cams, the lower track controlling the lower punches, and the upper track the upper punches. At the commencement of the cycle, the lower punch is brought down to the bottom of the track by the lowering cam (21), thus allowing the material to flow into the die to a maximum fill, the upper punch being held up at the maximum position by the cam track (20). When the lower punch has passed under the feed frame, it is lifted over the wedge (23), and the excess powder is spilled into the rear of the feed frame and passed on to the next cycle. This method ensures a good fill being obtained. As the lower punch is dropped back by its own weight to its bottom position, the upper punch is brought down by the cam (25) and seals the die. Both punches then pass along to the pressure point between the upper and lower roll (45 and 27). The upper roll is fixed while the lower roll is adjustable. The upper punch only enters the die a given amount, thus the tablet is always made in the top of the die. After the pressure has been applied, the upper punch is carried on the top of the tablet to prevent "capping" until it is lifted clear by the cam (26); during this period, the lower punch has been following, at a lower rate, up the cam (22). This ejects the tablet, which is scraped off by the front face of the feed frame, and the cycle is repeated.

Public's Guide to Plastics Household Goods

TO help housewives to care properly for the plastics goods they buy, Halex, Ltd., are now attaching informative labels relative to each of three types of plastics in their "Bex" range of household equipment. "We have introduced these labels," say Halex, "to help the public understand that plastics differ from each other, and to tell them how to obtain the maximum service and durability from the goods they buy. Now that plastics are used so widely, it is important that people should know to which category they belong, and how to treat them properly."

The melamine range in "Bex" household equipment includes cups, saucers and plates; polystyrene lines include kitchen canisters, refrigerator boxes, bread baskets and fruit bowls; among the polythene goods are large and small unbreakable wash-up bowls and egg trays.

As will be seen from the accompanying photograph, these labels, each worded separately for polystyrene, polythene and melamine, stress the main qualities of the material concerned, and give hints on the care of it. For example, the polystyrene label reads:—

This article is made of POLYSTYRENE.
Hygienic. Strong. Fast colours.

How to care for polystyrene: Plain water or mild soap suds are all that are necessary for cleaning. Never boil it or expose it to great heat. Under normal usage it will give you long and satisfactory service.

The information given on the other two labels is:—

POLYTHENE. Unbreakable and resilient. Odourless, tasteless, unaffected by all foodstuffs and domestic chemicals. Easy to clean. Withstands boiling water. Warm water and mild soap suds are all that are necessary to clean it. Do not use for boiling purposes or allow it to contact hot surfaces. Under normal usage this article is unbreakable and will give you long and satisfactory service.

MELAMINE. Does not easily stain. Strong. High surface glaze with feel and appearance of high-grade earthenware. Fast colours—cannot wash off. Tasteless, odourless. Warm water with mild soap suds is all that is necessary for cleaning. Do not use abrasives. With normal usage this article will give long and satisfactory service.

CONDITIONING PHENOLIC MATERIALS FOR STABILITY IN MOULDING

(Continued from page 73)

(2) Phenol loss varies directly with cure temperature and cure time.

(3) Ammonia loss varies directly with cure temperature, but is not appreciably affected by cure time.

(4) Loss of volatiles during moulding is greatest when preforms are preheated with higher quantities of moisture added.

In attempting to set up conditions which will properly prepare phenolic materials for stable mouldings, it may be seen that due consideration must be given to the conditions of service which the part is expected to meet. For normal variations in humidity and for interior service it appears evident that a normal moisture content of from 1 to 2½ per cent. provides the most suitable overall condition. For high humidity application it is generally better to use moulding material with a higher moisture content, while for high temperature or dry conditions it will be generally better to use moulding materials with low moisture content. In cases where physical strength is of particular importance careful consideration should be given to the preheating technique to assure optimum physical properties.

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Successful Designing for Plastics Moulding—XXX

By W. M. HALLIDAY

Further useful design factors are here considered as influencing styling and quality of appearance. Special reference is made to the use of partial or wholly decorative features such as lettering and figured impressions.

HIGH-GRADE surface finish, smoothness, clean and graceful lines, pleasing contours, excellent light reflectability, and good "eye appeal," are of particular importance with many plastics mouldings. Those design factors having a bearing upon the quality of surface finish, external appearance, and the æsthetic value of a moulded article, will therefore deserve careful consideration by both the component designer and the mould designer.

Value of Styling

Design characteristics of a purely functional nature should be determined by a person possessing sound engineering knowledge. It frequently happens, however, such a person will not have a comparable degree of proficiency and understanding of the artistic values, or æsthetic properties. To the extent these latter are lacking, the decorative qualities of the finished moulding may be deficient, and the resulting appearance value may be poor.

To overcome these drawbacks it will generally prove advisable to have a projected component design checked by a professional stylist or artistic designer, to ensure that the best possible use is made of decorative factors, and a successful balance is obtained between functional and style values. By this means, a component may be more properly assessed in relation to functional requirements, the possibilities of reproduction, and the exigencies of mould making.

Such a check should be made at an early stage in the development of the design before the basic features have been finalized. If consideration of the application of decorative qualities to a moulded article is deferred until after the mould design has been formulated, it may well be found that certain desirable artistic features will not be permissible. Nothing is more conducive to mar the finished appearance of the product than a number of isolated unrelated features which give the impression of being an after-thought to brighten up the article.

In previous articles in this series mention has been made of the various design features available whose effect will be to enhance appearance values. These relate to the use of the most satisfactory external shapes and forms, and use of slightly curved instead of perfectly flat surfaces. Further, by using flutings, beadings, ribs, panels, hatching and stippling on large surfaces, additional means will be at the disposal of the component designer for improving appearance. Use of such design features may also increase the strength, durability, and usefulness of the article.

It should not be supposed that styling, as such, is able only to impart purely æsthetic values to the moulded article. Its judicious adoption may also improve both utilitarian and functional features. For example, by employing curved surfaces with appropriate shallow beadings, or ribs, instead of bossed large flat areas, recesses and inaccessible pockets may be avoided. Thus the tendency for dirt, moisture, and similar undesirable substances to accumulate on certain portions of the surface will be eliminated.

With certain kinds of domestic appliances, notably those required for dealing with fine powder, or sticky materials, and which have to be scrupulously cleaned after use, the elimination of awkwardly shaped recesses, pockets and deep corners is a matter of some importance. In many instances, by adopting cleaner lines, and suitably modified large surface areas, it will be found that the part will function more effectively.

Effective styling may also impart a subtle but well-pronounced effect in giving emphasis to some special feature. For example, a component can often be easily styled to give an appearance of sturdiness, strength, rigidity and solidity, when in actual fact its walls may be relatively thin, and the weight of the whole piece may be quite small. This will, of course, generally be achieved by the skilful application of beadings, ribs, flutes, and so forth.

The introduction of design features of this character may not only invoke the impression of great strength and robustness, but may actually serve to increase strength and stiffness to a marked degree. In earlier sections of this series the various ways in which this object may be attained by using bosses and ribs have been fully explained.

If the moulded component is of very large size, and complex or awkward in shape, a form of styling may be selected to subdue the influence of the more heavily massed or weighty portions. This will assist in producing an impression of lightness, which will enable the user more readily to manipulate the article during use.

With those mouldings required for an industrial purpose, where efficient functioning is of supreme importance, but where styling is difficult to apply, purely decorative features may often be introduced whose effect will be to soften the mechanical characteristics. In all cases of this kind, it will be imperative to ensure that styling and decorative features be embodied *originally* in the design. As a general rule, little useful effect will be gained where styling is adopted at the last stages of design development.

Sound styling, good appearance, and use of artistic details in their fullest meanings, should grow naturally, out of the basic functional design if the most successful results are to be obtained. By giving proper consideration to these matters during initial stages, when design forms are more or less "fluid," and certainly in their most flexible or adaptable forms, maximum opportunities for their adoption will be afforded the designer.

Styling and Mould Design

As with the purely functional or utilitarian features employed with a moulded component, so the character of styling and decorative features will often have considerable influence upon mould design, construction and use. Their introduction should always be adjudged from these three standpoints.

Modern design, and sales requirements, too, often tend to demand simple forms, clean-cut exterior lines, and with the use of certain decorative embellishments on a moulded component. The emphasis lies in the avoidance, or maximum suppression, of purely functional features on all plainly visible outer surfaces, and the use of curved, relieved, or slightly impressed surfaces in place of ones perfectly plain and straight. In general, this will lead to component designs which are very favourable. Their adoption, however, may not be equally favourable, or even economical from the mould design, construction and operating viewpoint.

The adoption of such features may mean that similarly curved, broken or interrupted surfaces will be required in the walls of the critical mould-matrix. The reproduction of such features in the tool will nearly always mean an increase in machining problems and time, a greater amount of setting-up of the tool for such machining, and a greater amount of attention in the form of hand-polishing the mould.

To a certain degree these additional

costs may be avoided by the adoption of the "hobbing" method of cavity formation. This method, on the other hand, is only applicable to certain shapes of component which, coupled with certain other limitations, means the process is only applicable to a modest proportion of component designs.

From the mould machining and construction standpoints, simple geometrical shapes, flat surfaces disposed in one plane and devoid of protruberances, etc., or those shapes capable of being reproduced by rotary cutting actions, viz., cylinders, cones, and spheres, will generally simplify mould manufacture to the maximum degree. This latter benefit will arise mainly for two reasons. Firstly, large flat surfaces, or any of the other regular shapes just mentioned, may be very quickly formed by the usual machining processes. Secondly, greater accuracy will usually be attained in reproducing such simple shapes. It will, indeed, often be possible to reproduce them by ordinary milling or turning processes, as distinct from die-sinking from an enlarged copy master template, or by hobbing.

Certain practical advantages may also be gained from the use of these simpler geometrical forms in the case of the finished moulded article. For instance, because of its more uniform and regular shape, the mould designer may be enabled to employ a simple single-plane parting in the mould, and the location of this in such a manner that parting-line flash will occur on a non-essential surface or edge thereof. Such shapes will also be conducive to simple means of flash removal.

The design of jigs and fixtures required for later machining, testing or assembly operations on the moulded component may also be simplified, since components having flat surfaces and regular outline shape can be adapted for fitment into a holding jig much more readily than one of an irregular shape. Generally, it will be preferable to avoid the use of large plain flat surfaces, except where these are necessary to allow the part to be matched more evenly and closely with some other component, or where functional requirements demand surfaces of this character.

True flatness of surface will be difficult to attain and maintain over long production runs with either injection or compression moulds, with the exception of those designed to produce mouldings of very small size. This will be due to the unavoidable intervention and effects of numerous factors occurring during the moulding stage, which usually are most difficult to control. Briefly, these factors are:—

(1) Variations in the rate of material shrinkage occurring over various different portions of a moulding. This will be prone to arise where the wall thickness varies to a considerable extent, and/or where extensive coring is employed at certain points.

(2) Variations in the "flow" or running capacity of the plastics material entering different portions of a complex mould cavity. Flow may be retarded by excessively thin wall sections, by the interjection of fixed cores across the main stream of flow, by unequal thermal balance of the mould, and so forth.

(3) Unequal expansion and contraction of the mould itself due to variations in working temperature or pressure.

(4) Use of deteriorated or contaminated moulding materials.

(5) Methods for extracting cores, and ejecting from the mould. In the case of components having large flat areas which are relatively unsupported, great care will be required in the disposition of ejector rods, so that warpage and distortion will not occur as a direct result of unequalized ejector-rod contact and pressure.

Large flat perfectly plain surfaces on a moulded component will usually fail to enhance good appearance by their tendency to accentuate minor blemishes. This will be the case especially where the defect is in the form of a slight depression, or raised patch in relation to the remainder of the surface. The poor light-reflecting capacity of the large flat surface will tend to heighten such raised or sunken spots, thereby emphasizing rather than hiding their presence. Plain or flat surfaces are also particularly prone to reveal flow marks, an irregularity commonly arising with compression mouldings, and which may be somewhat difficult to eliminate.

Slightly curved surfaces, especially of convex formation, give superior representation of high-lights by radiating reflected light-rays over a wider field, thereby creating subtle mild shadows. For the same reason, eye-strain will also be reduced in comparison with that associated with a flat surface.

This does not necessarily mean that a great amount of curvature will be necessary on external surfaces of a moulding. On the contrary, in the general run of cases, where such a shape is adopted to make the finished surface more interesting, etc., a very slight degree of crowning will usually give best results.

In the same way, ribs, flutes, beadings, stippling, and similar relief employed purely for improving appearance, need only be raised a very slight amount above the normal surface of the part. The best results will generally be obtained by maintaining such decorative features in low relief, i.e., from .010 to .030 in. above the normal surface level. Many designers make the mistake of applying excessive "relief" by using flutes, beads, and ribs of considerable height. This may not only cause some detraction from good appearance by introducing heavy shadows, but may also entail disadvantages in mould manufac-

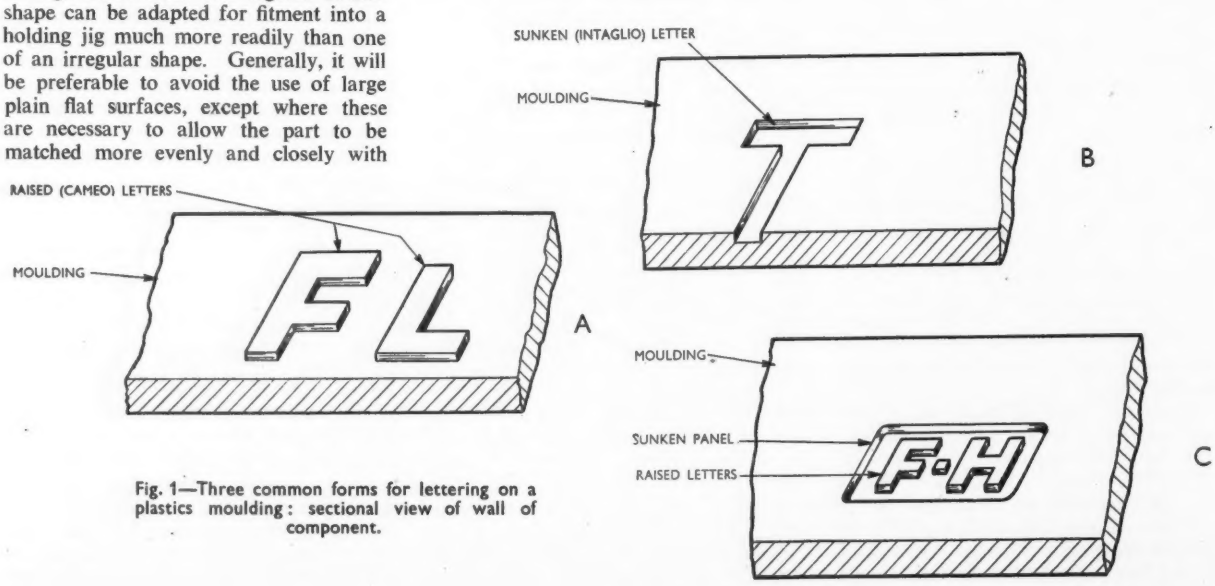

Fig. 1—Three common forms for lettering on a plastics moulding: sectional view of wall of component.

ture, which will often be rendered more costly by the larger amount of machining and polishing required.

Many mouldings possessing uninteresting flat surface areas may be embellished by ornamentation with conventional geometrical design forms, in the form of symbols and lettering. These, again, will be formed in very shallow relief. Such ornamental work may be easily reproduced in the walls of the mould cavity, by the hobbing method, or by die-sinking from an enlarged master pattern.

Lettering and Figured Motifs

Two further useful and important design features remain to be considered, viz., lettering and figured motifs. The use of these will enable the designer to achieve the dual purpose of increasing usefulness and improving the appearance of a moulding.

It is often necessary to employ lettering on the external surface to convey working instructions, name of the maker, patent number, etc. Similarly figured symbols, such as trade marks, positions to be occupied by various elements of the finished assembly of mouldings, etc., may have to be moulded, with slight raised relief on some surface of the component.

Three methods may be employed in the use of such lettering or inscriptive figures:—

(1) The letters may be raised directly from the normal surface of the part; this will be known as a " cameo " impression, as seen at A (Fig. 1).

(2) The letters may be sunk into the wall of the component, so that their crests will lie below or level with the normal surface; this is known as an " intaglio " impression, as seen at B Fig. 1

(3) A sunken or raised panel may be employed, upon which localized surface lettering, etc., raised or recessed, may be immured; this form is termed the " panelled " impression. The panel background may be raised in cameo fashion from the surface of the moulding, and have intaglio-type lettering imposed thereon. Alternatively, the panel itself may be sunk into the wall of the component to a shallow depth and have raised cameo letters.

Example *C* (Fig. 1), showing panelled impression style lettering, illustrates a sunken rectangular panel background having raised or " cameo " letters. It will be noted that the tops of the letters lie level with the main surface of the moulding; this is one of the most common design practices.

Letters, symbols, numerals, etc., of intaglio form, that is *sunken* into the surface of the moulding, have to be formed by means of *raised* cameo impressions in the wall of the mould cavity. This is often quite feasible, but rarely economical, because it involves cutting away large quantities of metal in the mould cavity around the raised letters. In the case of intricate inscriptions and motifs, this operation may entail a great deal of time, with much protracted hand finishing.

Raised letters in the cavity wall of the mould may sometimes be formed by powerfully forcing in a " hob " having commensurate lettered recesses, into which metal will be induced to flow as the hob is forced into the mould block. A particular size and form of lettering would have to be employed, so that the recesses in the master hob would be conducive to metal flow.

It will be appreciated that the formation of such raised impressions in the mould cavity, by means of hobbing, after the fashion briefly outlined, will only be practicable if the lettering is located on the floor of the cavity, so allowing the recessed formations to lie on the end-face of the hob. If located on side surfaces, it would be impossible to penetrate the hob to proper depth, or extract it from the cavity afterwards, due to the locking action occurring between mould metal and hob. Likewise, if raised letters were to be machined by ordinary cutting means on the side walls of the mould cavity, difficulty would be experienced in extracting the finished moulded article, because of the interlocking action created by the formed letters.

These disadvantages may sometimes be overcome by employing loose, detachable or swinging pads, fitted so as to impinge into the side wall of a cavity, and upon which the necessary lettering may be machined or hobbed, before the piece is mounted in place. Means would also have to be provided for retracting or swivelling such pads so that the finished moulding could be easily extracted.

The presence of raised lettering on the cavity surfaces might also give rise to certain other disadvantages, especially when using abrasive mineral-filled powders in compression moulding. Such letters would of necessity be rather delicate, and if disposed athwart the main flow stream, might easily be adversely affected by frictional contact with the flowing material, the original clean-cut outlines and sharp impression being speedily lost, and high maintenance charges being involved in servicing the mould.

Raised lettered portions of a mould cavity are also sometimes adversely affected by the high working temperatures employed in moulding. This gives rise to heat-checking and probable erosion on knife edges and sharp corners.

For all these reasons it will be appreciated that the use of *depressed letters* on the surface of a moulded component will, from the mould construction and maintenance angles, prove much more onerous and costly, than for the case where reverse (cameo) impressions are employed.

Raised letters and motifs are formed by recessed intaglio impressions sunk into the wall of the mould cavity. The reproduction of such impressions will usually be far more simple and less expensive than with the reverse type of letters already described. Indeed, the only amount of metal stock to be cut from the mould cavity walls will be that occupied by the letters themselves. These sunken impressions may be formed much more simply, either by means of ordinary cast-steel stamps, by milling from master templates in the die-sinking or engraving machines, or by fitting small separate pads or plates. Only in certain cases will " hobbing " be feasible, owing to the necessity to make such raised lettered portions on the surface of the hob of substantial proportions so as to resist the high reaction pressures, and the effects of metal flow.

The sharp edges and corners of the *sunken impressions* required in the mould cavity will not be affected to the same adverse degree by heat or the friction of flowing material, thus greater durability and close accuracy will be obtained. Sunken lettered impressions having light relief may be cut directly into the solid metal walls of the mould, or be formed in separate pads or cores. These latter may be fitted either as permanent fixtures or arranged to retract, swivel, or move in convenient manner.

The use of a panelled background of the kind illustrated at *C* (Fig. 1) will generally prove particularly helpful in the case of impressions to be formed on a pad or slide. This latter mould member may be adapted to correspond in shape and size to that of the desired panel. It may also be adjusted and fitted relative to its projection into the critical cavity area to give any desired degree of relief.

(To be continued)

PLASTICS INSTITUTE "TRANSACTIONS" for January, 1952, contains a very complete index to all previous issues since commencement of publication, i.e., Vols. I to XIX (1931-1951) inclusive. This index has been compiled by Mr. W. A. Cook. hon. editor of the " Transactions." Its price to non-members of the Institute is 15s. The issue also contains articles on " Pre-heating moulding materials, with particular reference to live steam heating " (H. H. Ball), " Some developments in modern hydraulic presses " (W. R. Groves), " Developments in plastics moulding plant, with particular reference to automatic operation " (J. L. Daniels), " Some plastics and their uses in surgery " (Dr. John T. Scales), and " Extrusion problems " (K. Leyland). Additional pages in each issue of the " Transactions" are now regularly devoted to a " Journal " giving news from various sections of the Institute.

PATENT REVIEW

The following abstracts have been made rom specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, price 2s. 6d. each.

B.P. 657,547. Appl. 15.12.47. Conv. (U.S.A.) 28.12.46. Acc. 19.9.51.

Artificial resins. G. R. Barrett. To: Monsanto Chemical Co.

A polymerizable vinyl compound of the formula $R\text{-}CH=CH_2$ (where R is a phenyl or substituted phenyl radical) is copolymerized with ethylene α-β- dicarboxylic acid anhydrides in a new manner.

B.P. 657,551. Appl. 31.12.47. Conv. (Germany) 18.9.42. Acc. 19.9.51.

Cold hardening phenol formaldehyde resins. Spolek pro Chemickon a Hutní Vyrobu NP.

0.1–5% of certain halides are added to a suitable mixture containing liquid resins of the resol type.

B.P. 657,606. Appl. 7.9.49. Acc. 19.9.51.

Thread reel. E. Minta.

The reel is moulded of two open hollow shell halves with internal stiffening ribs, and made from polystyrene or polythene.

B.P. 657,782. Appl. 3.11.48. Acc. 26.9.51.

Electrically insulating coating compositions. C. R. Pye, H. F. Bremer. To: Indestructible Paint Co., Ltd.

A mixture of an etherified urea-formaldehyde resin (melamine-formaldehyde resin) and a partial polymeric ester of a polyhydric alcohol and a saturated aliphatic $\alpha\omega$-dibasic acid (acid value between 70 and 110) is dissolved in one or more organic solvents.

B.P. 657,811. Appl. 9.10.46. Conv. (U.S.A.) 20.10.45. Acc. 26.9.51.

Chlorinated polymerized methacrylates. To: Ridbo Lab. Inc.

Flame and fireproof transparent or pigmented moulded articles are obtained from a chlorinated polymerized alkyl and aryl methacrylate produced by dissolving the methacrylate and subjecting the solution to chlorine gas at above 60 degrees C. until three, preferably four or more, chlorine atoms are substituted in each structural unit of the polymer.

B.P. 657,813. Appl. 6.1.48. Conv. (U.S.A.) 13.5.47. Acc. 26.9.51.

Extrudable compositions. J. W. Baymiller. To: Armstrong Cork Co.

An extrudable cork composition contains a resinous binder, cork particles and a paraffin wax solution of a rubber-like copolymer of an open chain aliphatic conjugated diolefin and alpha-methyl-para-methylstyrene.

B.P. 657,867. Appl. 17.3.49. Conv. (U.S.A.) 26.4.48. Acc. 26.9.51.

Vinyl resin coating. To: Bakelite Corp.

An aqueous mixture of chromium trioxide and phosphoric acid added to a water-insoluble hydroxylated vinyl resin dissolved in an organic solvent is suitable for coating metals.

B.P. 657,956. Appl. 1.4.49. Conv. (U.S.A.) 2.4.48. Acc. 3.10.51.

Methods of securing together adhesively a portion of material comprising a plasticized cellulose ester, a plasticized rubber hydrochloride and a second portion of material. T. C. Morris, E. C. Johnson. To: B.B. Chemical Co., Ltd. (Add to B.P. 638,085.)

B.P. 657,980. Appl. 22.4.49. Acc. 3.10.51.

Bottle stopper. A. E. Slatford. To: Viscose Development Co., Ltd.

A synthetic-resin or other cap and a cork are held together by wax or like thermoplastic material poured hot into the annular space between the two parts.

B.P. 658,051. Appl. 25.5.49. Acc. 3.10.51.

Mending or darning appliances. D. C. Hungerford. To: Hungerford Plastics Corp.

A pair of moulded plastic sections are united along a longitudinal centre line to form a "darning egg" with handle. One section is light coloured, the other dark.

B.P. 658,144. Appl. 7.6.49. Conv. (Austria) 6.7.46 and 18.7.46; 4.2.47. Acc. 3.10.51.

Artificial teeth. L. Egger.

The tooth comprises a support and a crown of non-elastic polymerizable synthetic material and an intermediate layer of elastic polymerizable synthetic material. Support, crown and intermediate layer are polymerized together. The tooth may be part of a denture with a base plate of polymerizable material.

B.P. 658,157. Appl. 20.6.49. Acc. 3.10.51

Presses for neck ties. H. A. Holt.

The press has a tapered base with side walls and a tapered slide. The tie lies in between. The press may be moulded in plastics.

B.P. 658,180. Appl. 23.9.47. Acc. 3.10.51.

Coating and adhesives. H. Ewing, A. Mellor.

Cellulose acetate products have a coating of polyvinyl chloride plasticized with a neutral ester of a certain composition.

B.P. 658,244. Appl. 22.3.47. Conv. (U.S.A.) 5.12.46. Acc. 3.10.51.

Apparatus for bonding sheet thermoplastic material to thermoplastic and other materials. C. S. Charron, L. Crawford-Brown.

The material is pressed between dies. One of the dies is heated under thermostatic control, pressure is also controlled, while a timer mechanism indicates the predetermined time of operation.

B.P. 658,248. Appl. 30.7.47. Conv. (U.S.A.) 22.3.46. Acc. 3.10.51.

Flexible film bearing a design and method for producing same. M. A. Chavannes.

A continuous layer of film is formed over the design printed on a carrier; this film comprises a solution of finely divided vinyl resin particles in a liquid plasticizer. The design may be formed of a resinous vinyl copolymer of a relatively high average molecular weight. Design and film may be fused by heat, then stripped off the carrier.

B.P. 658,258. Appl. 2.1.48. Conv. (Australia) 23.1.47. Acc. 3.10.51.

Methods and apparatus for welding thermoplastic articles. V. A. Duffy.

A metal wire or sheet shaped to the configuration of the weld is placed on the thermoplastic sheets. The pressure is applied while an electric current passes through the metal.

B.P. 658,269. Appl. 2.4.48. Acc. 3.10.51.

Production of articles from synthetic resinous material. C. G. Evans, A. Baker. To: National Research Development Corp.

At least two permeable reinforcements are employed. Each reinforcement is impregnated with a carrier resin, one with a metahydroxyphenol, the other with an aldehyde. They are brought into intimate contact forming a composite resin in both reinforcements and then cured. The method reduces the heat and time required in the production.

B.P. 658,296. Appl. 18.9.48. Acc. 3.10.51.

Manufacture of microporous sheets of hard rubber. E. W. Madge, F. T. Purkis. To: Dunlop Rubber Co., Ltd.

A layer of foamed latex is vulcanized without destroying the foam structure.

B.P. 658,301. Appl. 14.10.48. Acc. 3.10.51.

Polymeric products derived from diolefines and vinyl aromatic compounds. A. Abbey. Comm. from: Dow Chemical Co.

B.P. 658,312. Appl. 22.3.49. Acc. 3.10.51.

Process for the repair of spectacle frames, or other articles made from cellulose acetate sheet, celluloid, nitrocellulose, or other organic thermoplastic substances. J. H. Stubbings.

B.P. 658,322. Appl. 13.8.49. Conv. (U.S.A.) 22.4.49. Acc. 3.10.51.

Musical toy. To: Cowan, De Groot, Ltd.

The toy is made up of a plurality of tuned tubes in a certain arrangement with an indexing element for supporting a record and a mouthpiece. The indexing element is rotated over the opening of the tubes. The toy is constructed from plastics of contrasting colours.

B.P. 658,426. Appl. 6.9.48. Conv. (U.S.A.) 4.9.47. Acc. 10.10.51.

Polymerization process and products resulting therefrom. J. F. Corwin, G. A. McFarren. To: Borden Co.

Vinyl ester polymers or copolymer emulsions.

B.P. 658,444. Appl. 6.5.49. Conv. (U.S.A.) 5.8.42. Acc. 10.10.51.

Casings for artificially coloured foodstuffs. To: Transparent Package Co.

The casings are intended for skinless sausages and similar meat products and consist of a regenerated cellulose film uniformly treated with an edible colouring material (certified colours).

B.P. 658,530. Appl. 5.10.48. Conv. (Netherlands) 8.11.47. Acc. 10.10.51.

Multi-coloured sheets or coatings of polyvinyl resins. To: Balatum N.V.

A design is printed on a support (fabric; paper) in colours each formed of a suspension of a polyvinyl resin and a pigment in one or more plasticizers. The printed material is gelatinized by heat.

B.P. 658,539. Appl. 16.3.49. Conv. (U.S.A.) 21.5.48. Acc. 10.10.51.

Interpolymers. To: United States Rubber Co.

The amount of styrene and di-2-propenyl maleate convertible to a soluble polymeric resin can be very markedly increased by interpolymerization with a 2-propenyl alcohol. The new interpolymers are suitable for surface coatings, as thermosetting moulding powders, for rods, blocks, sheets. Dyes, pigments, fillers, plasticizers can be incorporated.

B.P. 658,741. Appl. 23.7.47. Conv. (U.S.A.) 23.7.46. Acc. 10.10.51.

Polymerization. To: Brit. Thomson-Houston Co., Ltd.

More rapid conversion of compounds containing polymerizable groupings is achieved by incorporating an organic peroxide catalyst and adding an organic reducing phosphorus containing compound. Especially useful in applications such as castings and mouldings for electrical insulating purposes, for coating compositions, for moulding under heat and pressure, for thin films.

BM163

The washing machine agitator is made from phenolic material for Thor Appliances Ltd.

The 'Crispator' is made from polystyrene material for the Pressed Steel Co. Ltd., of Oxford.

The vacuum cleaner nozzle is made from P.V.C. material for Vactric Ltd.

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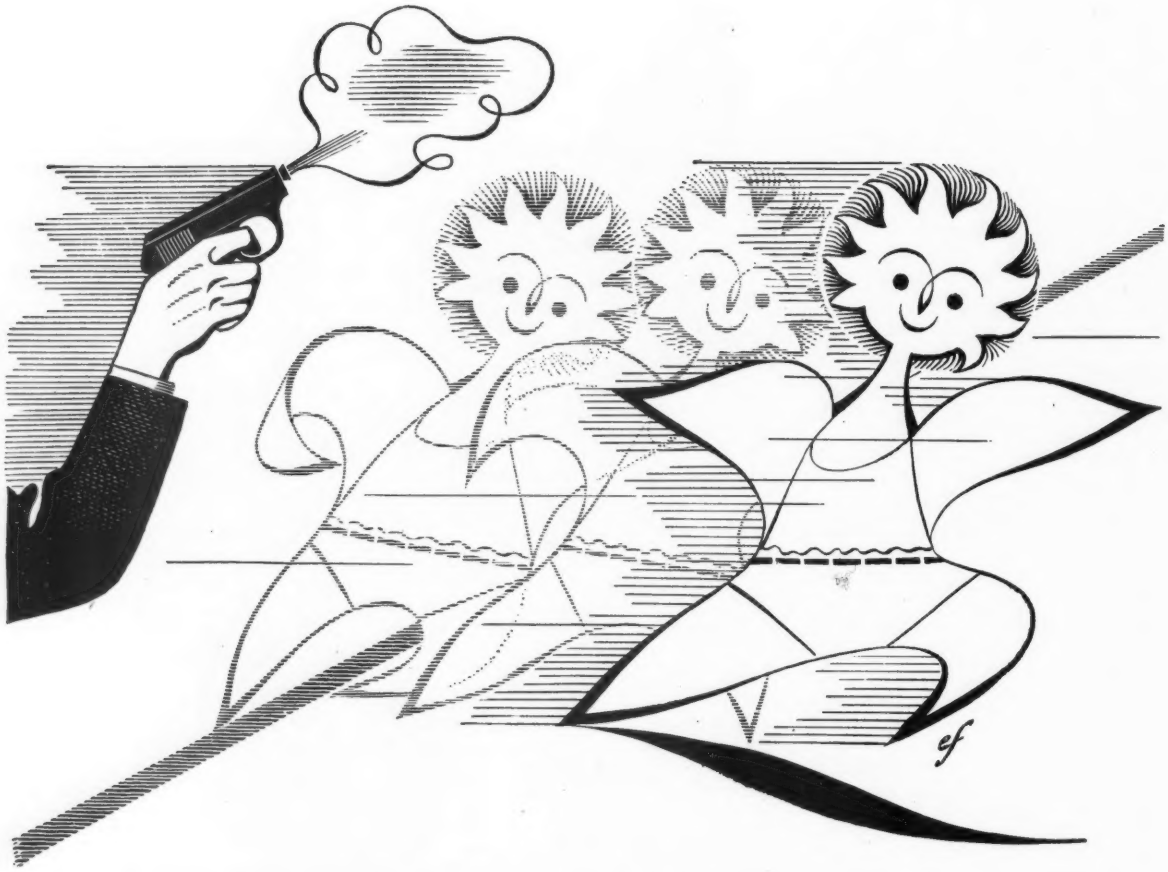

I'M VERY QUICK OFF THE MARK! says Mr. Therm

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Publication 1676 deals fully with the use of cadmium pigments in Polyvinyl Chloride, and we shall be glad to send copies on request. Please do not hesitate to write us regarding any pigmentation problems you may encounter.

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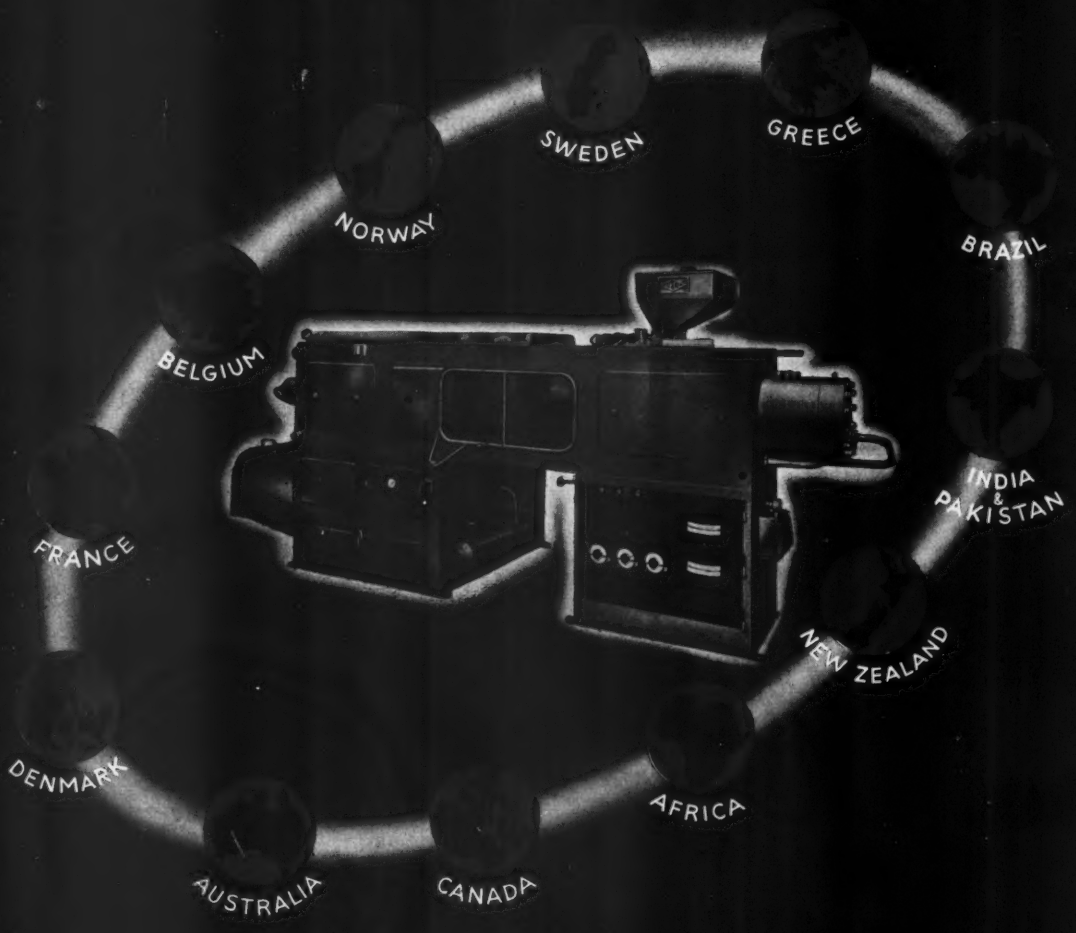

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PICO PRODUCTS

THE PROJECTILE & ENGINEERING CO. LTD.

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FORMICA REGD.

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Nursery Section showing FORMICA surfaced tables in Buff and Blue alternate rows.

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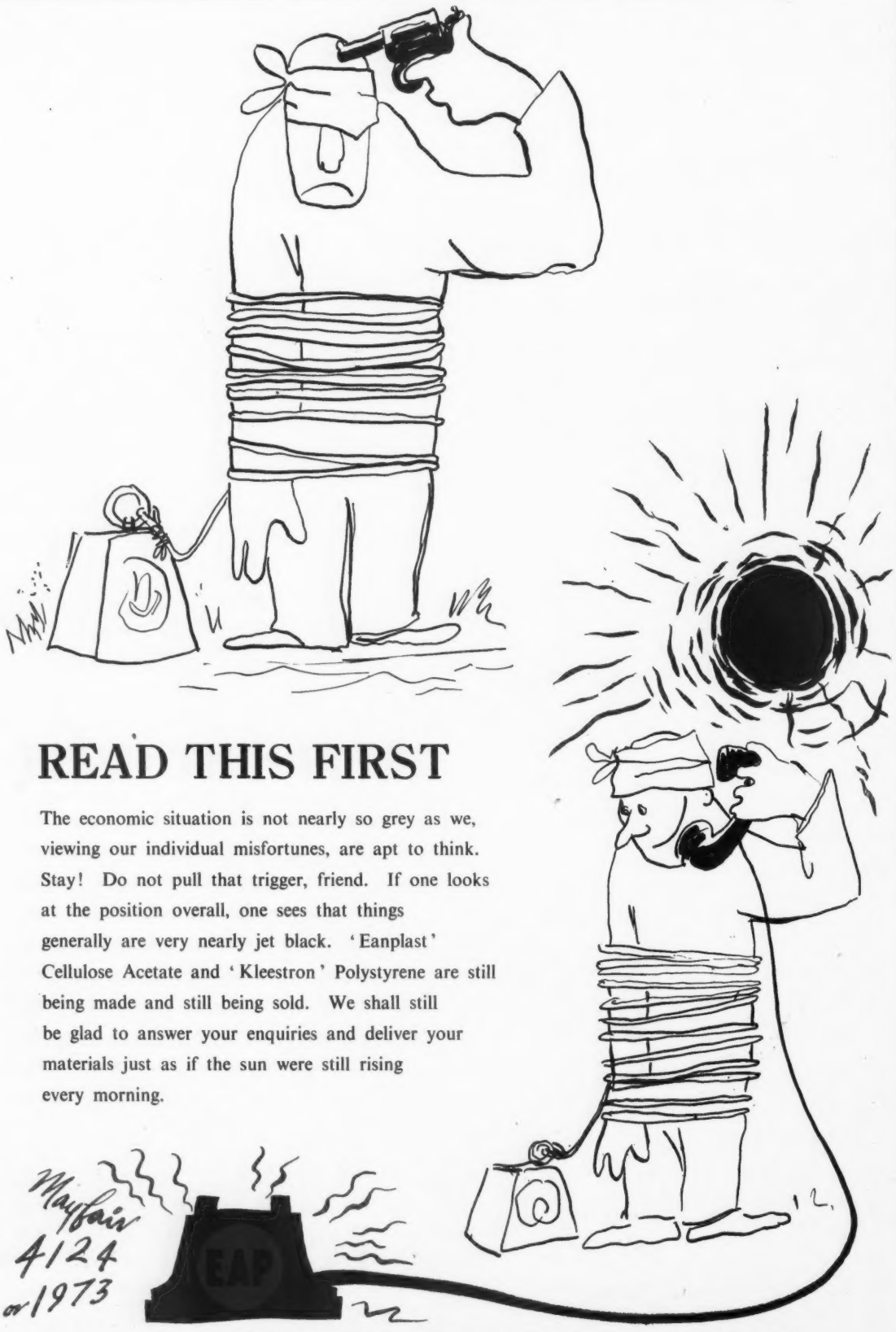

READ THIS FIRST

The economic situation is not nearly so grey as we, viewing our individual misfortunes, are apt to think. Stay! Do not pull that trigger, friend. If one looks at the position overall, one sees that things generally are very nearly jet black. 'Eanplast' Cellulose Acetate and 'Kleestron' Polystyrene are still being made and still being sold. We shall still be glad to answer your enquiries and deliver your materials just as if the sun were still rising every morning.

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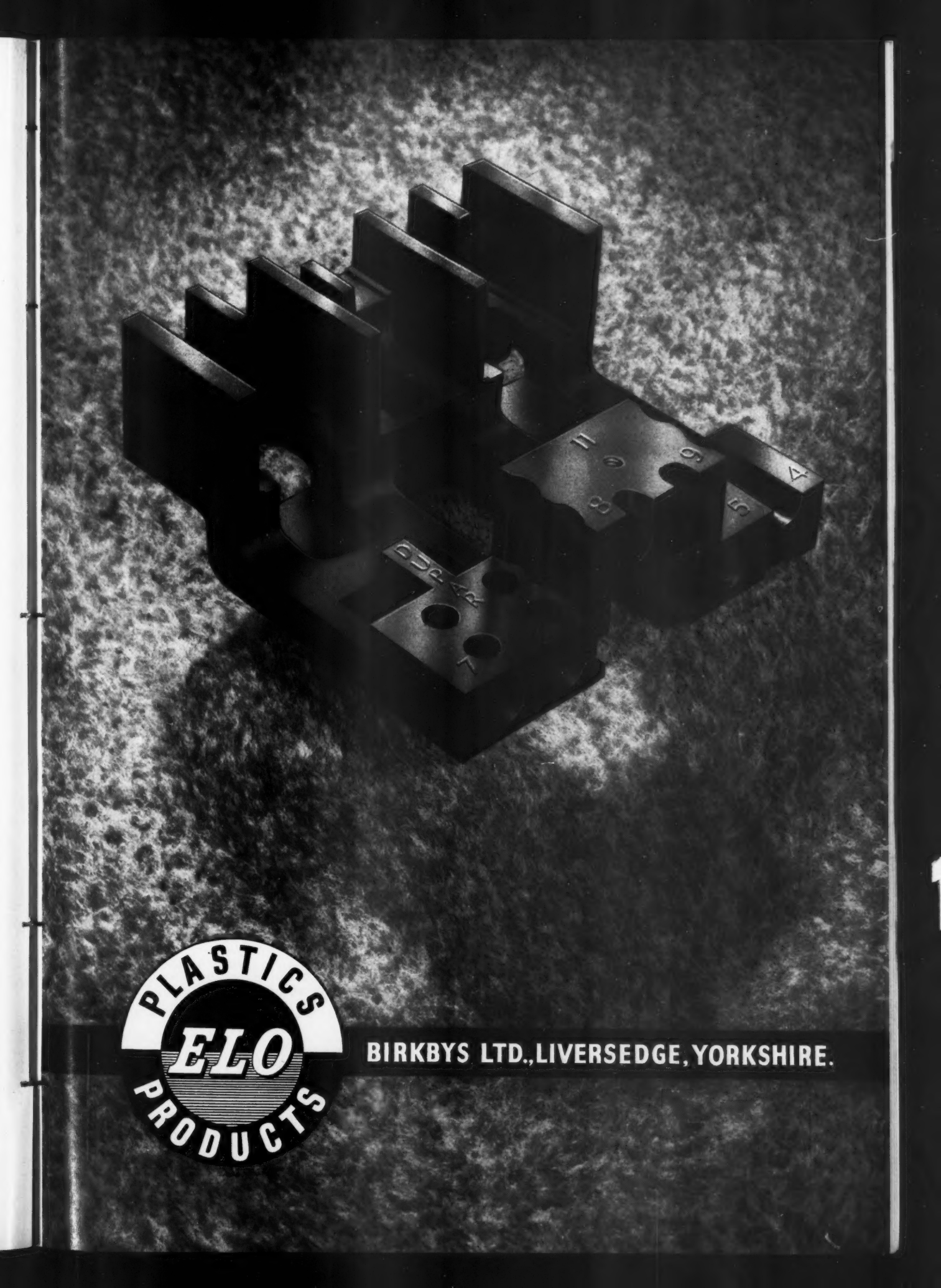
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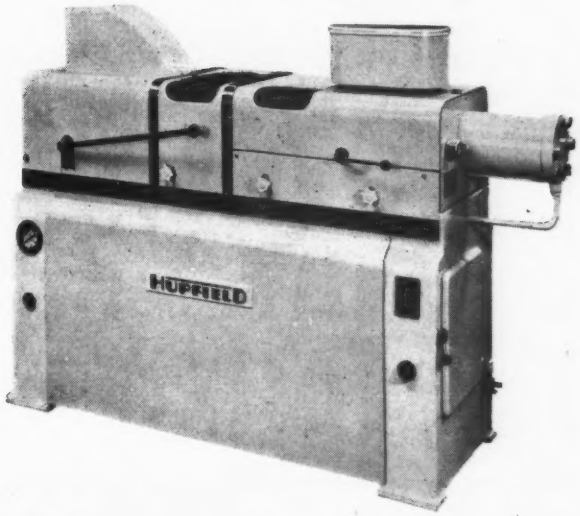
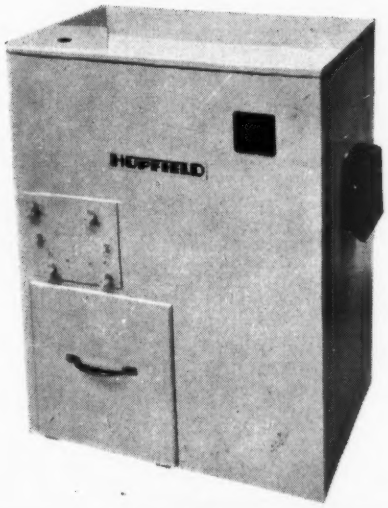
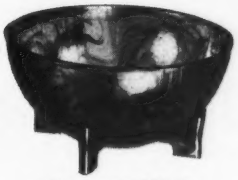
	1 oz.	2 oz.
Mould area approximately..	12 sq. in.	22 sq. in.
Plasticizing capacity per hour	9 lb.	18 lb.
Injection pressure	5½ tons	11 tons
Mould locking pressure ..	22 tons	44 tons
Shots per hour, subject to mould design	350	250



GRANULATING MACHINES

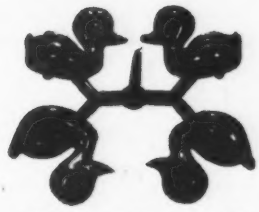


Granulates all thermoplastic materials, delivers at the rate of 80 lb. per hour. Cutting blades are adjustable and easy to clean. Completely self-contained with 2 h.p. electric motor.

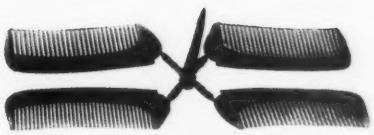


polystyrene 3¾" dia.
25 seconds. 1 ounce.

Mouldings from our 1 ounce machine.



cellulose acetate 5½" × 5"
30 seconds. 31 gramme.



polystyrene 8" × 3½"
20 seconds. 24 gramme.

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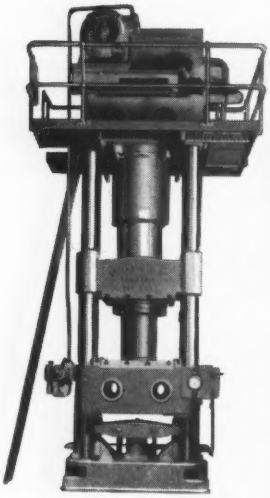

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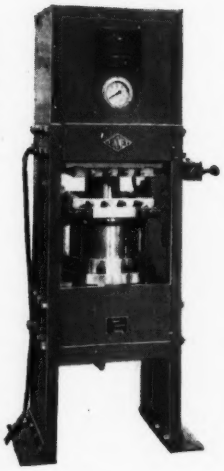

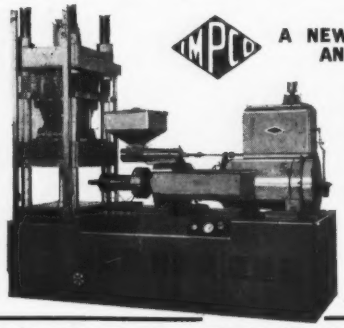

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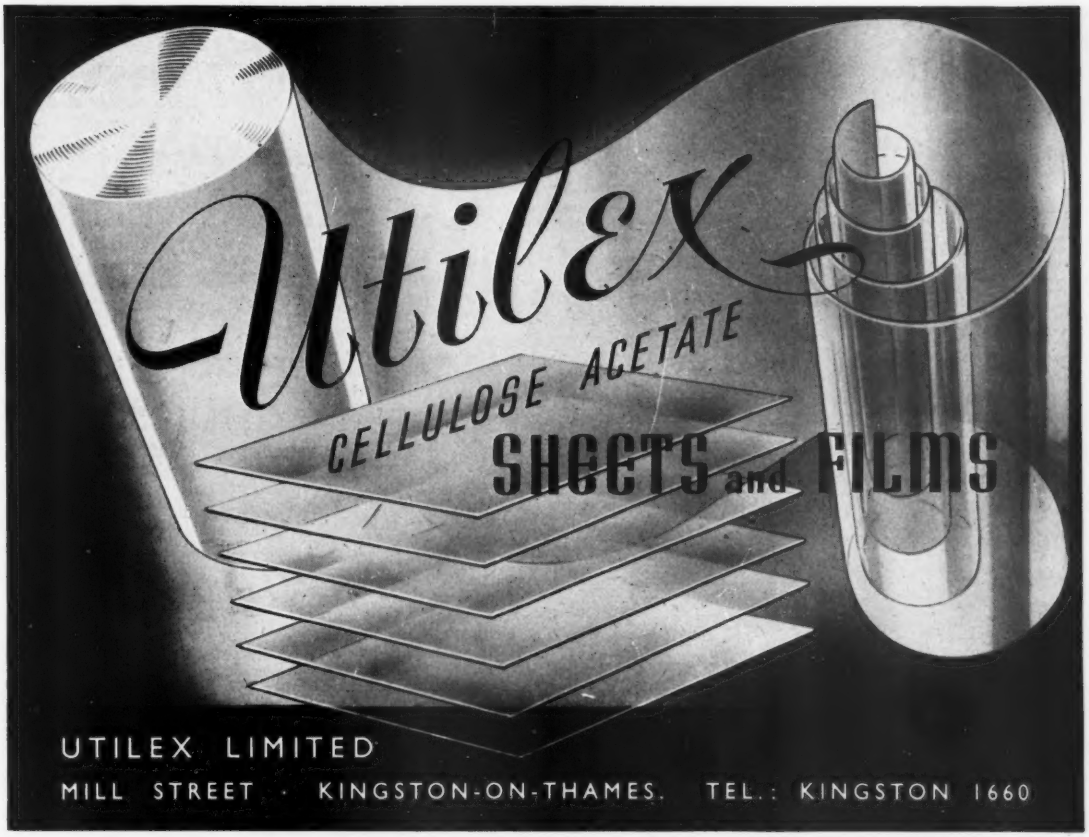
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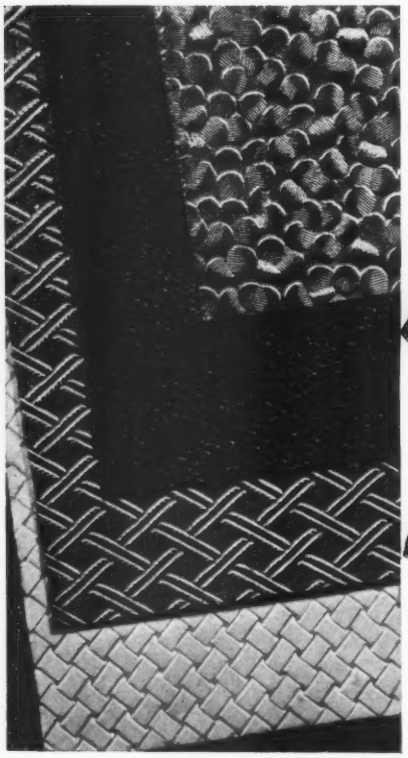

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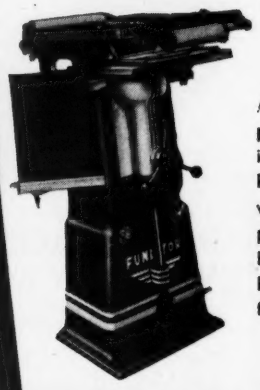

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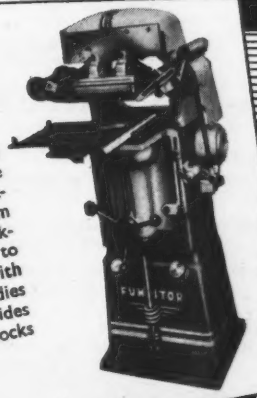

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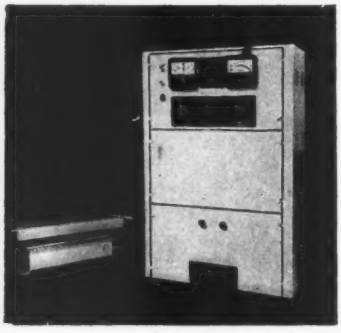

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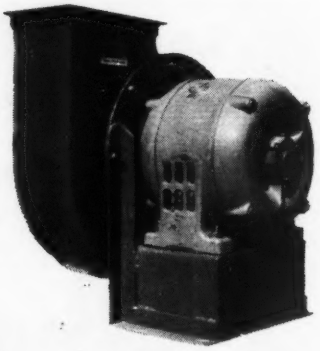

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600-ton PRESS by JOHN SHAW. Two Upstroking Rams 19 ins. dia. × 4 ft. stroke. W.P. 2,500 lbs. sq. in. Working area of head 97 ins. × 88 ins. Two independent moving tables each 60 ins. × 48 ins. Press is suitable for fitting with heated platens if required.

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100-ton Downstroke PRESS by BRADLEY & TURTON. Ram 12 ins. dia. × 9 ins. stroke. 4 columns having a distance between of 1 ft. 8¾ ins. × 10¾ ins. Fully guided table having a working area of 1 ft. 9½ ins. × 1ft. 8¾ ins. Arranged with single return ram and mechanical ejector mechanism. Complete with pre-filling tank and control valve.

80-ton Upstroke PRESS by TANGYE, having Ram 10½ ins. dia. × 16 ins. stroke. Four columns having a distance between of 16½ ins. × 14 ins. Working area of table 14 ins. × 14 ins. Daylight 16 ins. W.P. 1 ton. sq. in.

75-ton Upstroke Multi-Daylight PRESS having ram 10 ins. dia. × 18 ins. stroke. Four 4 ins. dia. columns. Press is arranged with seven platens size 28 ins. × 27 ins. × 1⅝ ins. to give 6 daylights of 4 ins. each. W.P. on Ram 1 ton sq. in.

Several 65-ton Downstroke PRESSES by RICE & CO., each having a glanded ram 9 ins. dia. × 15 ins. stroke. Fully guided table on four 3 ins. dia. columns having a working area of 13 ins. × 21 ins. Daylight 22 ins. W.P. 1 ton sq. in.

New 50-ton "COBORN" enclosed type self-contained Downstroking MOULDING PRESSES having a platen area of 17 ins. × 16 ins. Electrically heated and thermostatically controlled.

25-ton Upstroke PRESS by BRADLEY & TURTON, fully guided table on 4 columns, fitted with electric platens 10 ins. × 10 ins. Complete with control gears, valves, and guards.

Modern 10-ton Dual Unit by FINNEY. Rams 3 ins. dia. × 6 ins. stroke. Upstroking tables fully guided and fitted with return springs. Electric platens size 9½ ins. × 9½ ins. Complete with self-contained pumping equipment.

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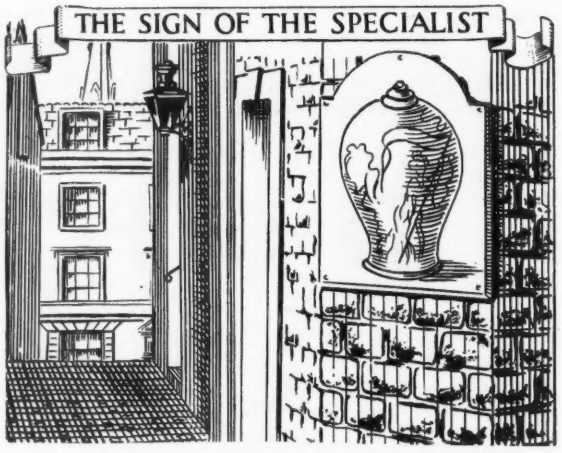

The China men or tea merchants of eighteenth-century London frequently displayed a jar or canister on their signboards, the Indian Queen also being used in many instances. Tea was then still the drink of the upper classes of Society and a century was to pass before lower prices and plentiful supplies brought it within the reach of all. Today, it is a universal drink and the specialist tea merchant has given place to the multiple grocer. But our familiar screw symbol may remind you that **we are still specialists in small turned parts.**

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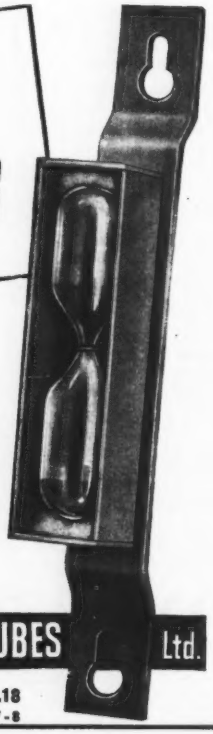

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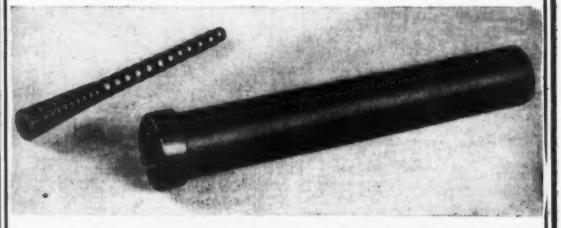

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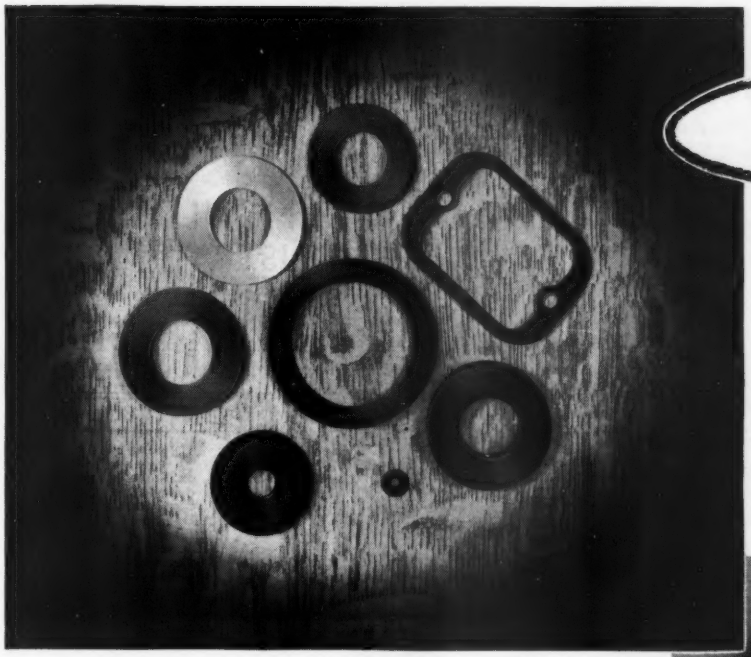

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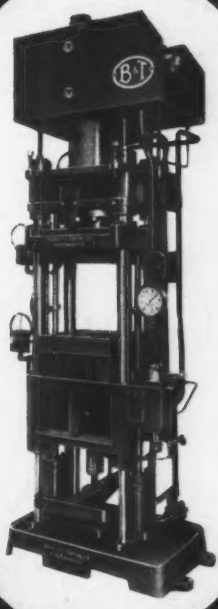

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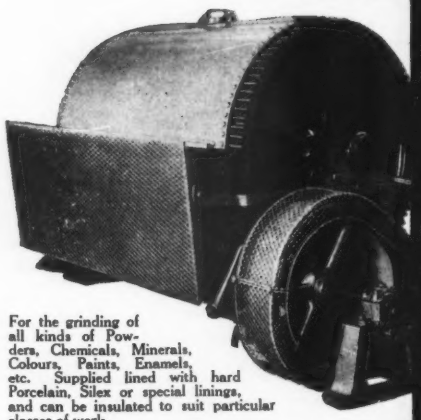

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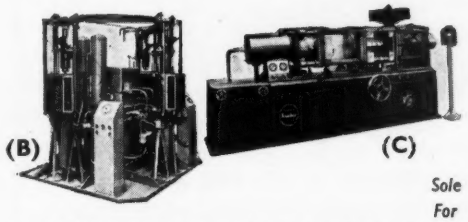

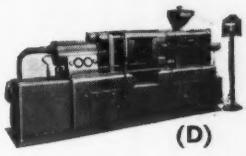

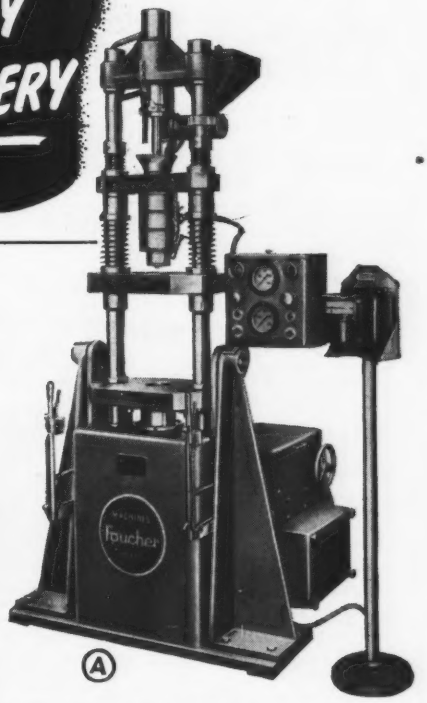

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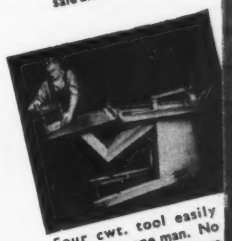

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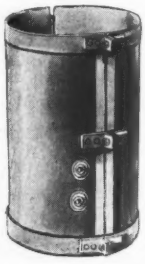

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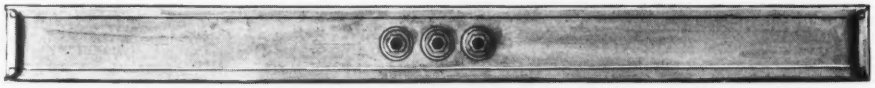

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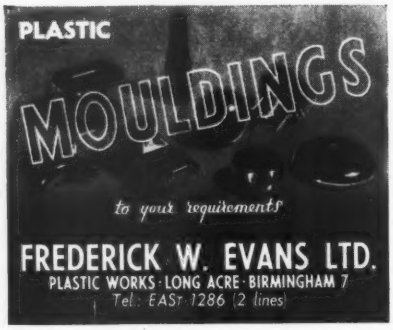

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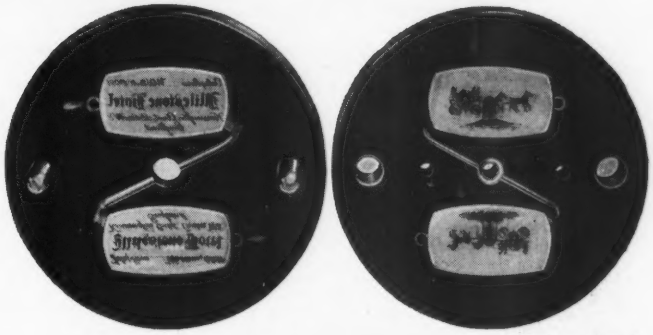

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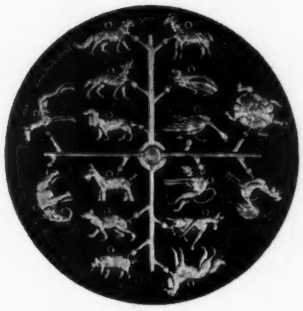

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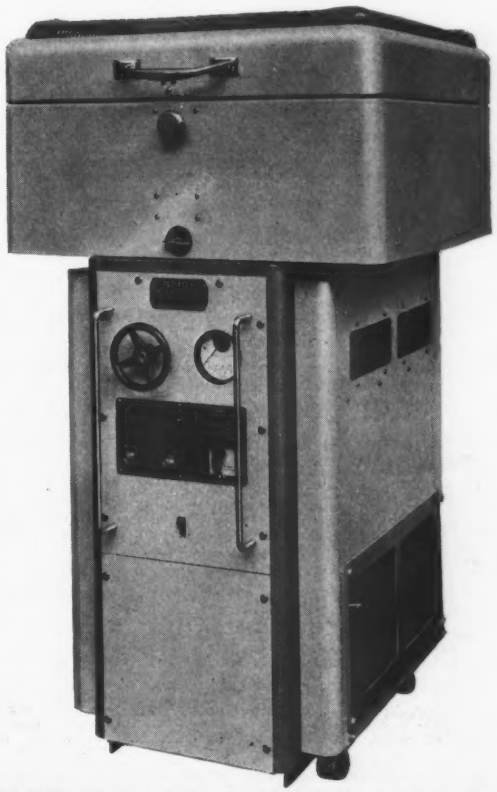

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35 h.p. Brooks slip-ring motor, 415 volts, three-phase, 50-cycles, 1,000 r.p.m., together with oil-immersed starter. Below.

Hydraulic Intensifier. Low pressure ram 22 ins. diameter. High pressure ram 9½ ins. diameter, stroke approximately 5 ft. Ratio 5½/1 to intensify from 800 lb. to 2 ton per sq. in. Below.

Small two-throw vertical hydraulic pump, by John Shaw. Working pressure 2 tons per sq. in. Automatic change from low to high pressure. Below.

Small two-plunger horizontal hydraulic pump. Two tons per square inch working pressure. Mounted on a tank. Below.

Will sell separately. Write Box P7520, care of "Plastics." 176-2809

TOOLMAKERS have six-impression teaspoon mould (compression) for sale. Brand new, chromium plated. Inquiries to Box P762, care of "Plastics." 176-14

POWER PRESS, 8-ton, motorized, 1¼ h.p. three-phase, complete with new pittler, slides and guard, good condition, price £35. Box P7610, care of "Plastics." 176-29

BRITISH FEDERAL WELDER, 17KVA., 400 volts, water-cooled, as new, price £55. Box P769, care of "Plastics." 176-30

COMPLETE INJECTION MOULDING PLANT, comprising two T.M.A. 3 ozs. hand-locked air-injected moulding machines, type E.L.9 Reavell two stages air compressor with 25 h.p. Brush motor, starter, piping and storage cylinders. Christy and Norris Briton powder mill, motorized and 7½-in., 5½-in. and 5-in. comb moulds. Box P764, care of "Plastics." 176-34

FOR SALE: Hydraulic pumps by Bradley and Turton, well maintained, may be seen at work, motor 400 v., 50 cycles, 3 ph. One to work two 80-ton presses, one to work two 25-ton presses. Will be free on delivery of larger power plant, due June, 1952. Apply Wipac Group, Bletchley, Bucks. 176-1

A. AND K. HAND TOGGLE PLASTIC MOULDING PRESS for sale. Steel plate frame, elect. heated tools max. stroke 5½ ins., centre to back 8¼ ins., die space ram down 9¼ ins. Hand ejector. Weight 9 cwts. Photo., etc. F. J. Edwards, Ltd., 359 Euston Road, N.W.1. 176-7

4 OZ. PECO INJECTION MOULDING MACHINE, nearly new. Reed Brothers (Engineering), Ltd., Replant Works, Cuba Street, Millwall, E.14. Phone, East 4081 (five lines). 177-2856

FUEL INJECTION EQUIPMENT for sale. New and reconditioned fuel nozzles for current H and K types English Electric Diesels. Both new and reconditioned injectors for Thornycrofts, 8.8 A.E.C.; 9.6 IDI A.E.C.; Ruston injectors and pumps and many others. All guaranteed. Injection service for all makes, including Deutz, Caterpillar, C.A.V., Bryce. Inquiries to R. E. Watson, 31 Maycross Avenue, Morden, Surrey. Liberty 4238. 177-x1058

TWIN BARREL POLISHING UNIT, in very good condition, available for quick sale. Ritco Products (Bristol), Ltd., 3-5 Cart Lane, Bristol, 1. 176-x712

ONE NEEN VALLEY 2-OZ. HYDRAULIC INJECTION-MOULDING MACHINE (self-contained), motorized, 400/3/50. Box P7518, care of "Plastics." 176-45

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100- OR 150-TON DOWNSTROKE HYDRAULIC PRESS for compression moulding, fully self-contained with rotary pumps, etc. Daniels or Bradley and Turton for preference. Box P7522, care of "Plastics." 176-44

PRODUCTION CAPACITY AVAILABLE AND WANTED

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MANCHESTER, 1.
Central 0272, 1725, 1000. zzz-316

INJECTION MOULDING by I.O.G. Industries, Ltd., 41 Marshgate Lane, Stratford, E.15. Maryland 2804. 184-2728

DINES PRODUCTS, Stanley Road, Grays, Essex, for injection moulding. 178-2729

COLD PLASTICS. Any party interested in making bulb bowls for small private concern please contact Miss E. Cameron, Stobieside, nr. Strathaven, Lanarkshire, Scotland. 176-x877

HIGH VACUUM. Dohms have large high vacuum plants for contract work. Dohm, Ltd., 167 Victoria Street, S.W.1. 176-327

MOULDING CAPACITY available up to 3 ozs. injection and 50 tons compression. Small electrical medical equipment mouldings our speciality. Solsway Plastic Laboratories, Ltd., Lancaster Road, High Wycombe. Phone, High Wycombe 2136. 181-2861

CONSULT GLENWOOD PRODUCTS, High Street South, Dunstable, Beds, for "Perspex" fabrication. 181-2859

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BELEY MICA PLASTIC CO. for injection moulding. Tools if required. Phone Leytonstone 2639, or call 252-6 L.M.S. Railway Approach, High Road, Leytonstone, E.11. zzz-328

CUTTING SERVICE available for all thin plastic films. We cut from rolls into sheets or small pieces dead accurately. Cellulose acetate. Cellophane, Pliofilm, etc., thinnest grades also handled. Apply, Morol, Ltd., 21 Woodthorpe Road, Ashford, Middlesex. 176-37

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FAIRMAN PRECISION TOOLS AND PRODUCTS, LTD., of Horley, Surrey, have capacity for the manufacture of Bakelite and plastic moulds, die-casting, dies, press tools and special-purpose machines. Also all classes production machining. Phone, Horley 909. 184-2735

INJECTION MOULDINGS IN THERMOPLASTICS. Mouldings in styrene, acrylics and acetate. Design and toolroom facilities available for mould construction, inquiries invited. J. and E. Courtney, Ltd., 138 Stratford Road, Birmingham, 11. 177-2808

REPETITION in Ebonite, Erinoid, etc. Capstan lathe work. Mansell, Temple Street, Rugby. 185-2767

INJECTION MOULDING CAPACITY available up to 3 oz. Precision moulding a speciality. Guardian Plastics, 56 Bermondsey Street, London, S.E.1. 185-2766

RAW MATERIAL AVAILABLE AND WANTED

SCRAP. Offer to:—
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POLYTHENE SCRAP for disposal. Please inquire Box P7611, care of "Plastics." 176-21

WASHED ACETATE X-RAY SHEET, sizes 8½ ins. by 6½ ins. to 15 ins. by 12 ins. and parcels mixed sizes; Celastoid sheet, 27 ins. by 24 ins. by .015 in., in pink, green, blue; mixed acetate and nitrate rolls, 5 ins. by approximately 24 ft., with light imprint similar in sheet, approximately 24 ins. by 20 ins. by .003 in. Lists and samples from
Lloyd's, 2 High Street, Christchurch, Hants. Phone, Christchurch 504. zzz-302

PERSPEX! PERSPEX!! PERSPEX!!! Official stockists for I.C.I. acrylic sheets. Sheets cut your requirements. Fabrication and mounting specialists to the trade:—
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Raw Material Available and Wanted (contd.)

NEW CELLULOSE ACETATE SHEETS, black, 10/1,000-in., one side polished, approximately 3,000 lb., below works price, for sale. Box P7612, care of " Plastics." 176-22

BAKELITE LAMINATED S.R.B.P. AND S.R.B.F. SHEETS required in good condition. Write Box P7121, care of " Plastics." 176-2645

4½ TONS BUFF VIRGIN DIAKON MOULDING POWDER for sale. App.y, Box P6725, care of " Plastics." zzz-317

ERLANOS, LTD., 93 Aldersgate Street, E.C.1 (Monarch 4686), require Perspex and cellulose off-cut and scrap, clear and coloured, highest prices paid. 179-2769

2½ TONS REWORKED BLACK ACETATE, 15 cwt. virgin Erinoid baby pink acetate. All in sealed bags. Offers to Box P742, care of " Plastics." zzz-321

WANTED, polythene scrap. Write to Box P7416, care of " Plastics." zzz-322

CELLULOSE ACETATE MOULDING POWDER, cheap, 1-ton reprocessed, royal blue, ½-ton virgin green metallic. Box P7613, care of " Plastics." 176-23

PERSPEX SHEETS/SCRAP, clear and coloured, large stock, wide assortment at competitive prices. Apply Box P7534, care of " Plastics." 186-2813

THERMOPLASTICS WANTED: Perspex, cellulose, acetate, P.V.C., polythene, polystyrene, etc., in sheets, offcuts and waste, also all types of moulding powder. Send details Box P7533, care of " Plastics." 186-2812

" DELAFILA," THE INERT FILLER. A silicate of alumina, completely inert and of uniform particle shape, accurately ground to 10 degrees of fineness to suit all needs. Prompt deliveries. A product of The Old Delabole Slate Co., Ltd., Delabole, Cornwall. 177-326

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BLACK POLYSTYRENE, large quantity available at low price. Please write for particulars. Box P7614, care of " Plastics." 176-24

P.V.C. WANTED, virgin compound and clean scrap. We collect and pay cash. Box P741, care of " Plastics." zzz-320

FOR SALE. Butyrate and acetate tubing (new):—
80,000 ft. red Butyrate in 10-ft. lengths.
10,000 ft. red acetate in 10-ft. lengths. 1,700 lb. black acetate in 10-ft. lengths.
Diameters, O.D. .225 I.D. .098.
337 lb. of clear acetate capillaries.
John Castle and Co., Ltd., 5 Hurley Road, Kennington, London, S.E.11. Reliance 4274. 176-2807

ALL THERMOPLASTIC SCRAP wanted. Sell to the manufacturers who can pay best prices—promptly. Collection from your works if required. Samples and details to Almex, Ltd., Imperial Works, Watery Lane, Birmingham, 9. Phone, Vic 0238 and 0329; or 120 Moorgate, London, E.C.2. Phone, Met 9641. 176-2860

POLYSTYRENE SHEETS AND ROD. Sheets 28 ins. by 20 ins. and 22 ins. by 18 ins. Rod, various diameters, in 6-ft. lengths. Miltoid, Ltd., 34-36 Royal College Street, Camden Town, N.W.1. Phone, Euston 6467. 178-2866

REPROCESSED POLYSTYRENE, first-class quality, in many colours, matching to any special requirements. Please send your inquiry to Herbert Connor, 120 Beaufort Park, Falloden Way, London, N.W.11. 176-26

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Polyvinyl Butyral.
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CATALIN RODS. Large quantity for sale, 7/16-in. diameter, 21 ins. long, in translucent amber, red, blue; also tortoiseshell, honey mottle and black, at competitive prices. John Castle and Co., Ltd., 5 Hurley Road, Kennington, London, S.E.11. Reliance 4274. 176-13

POLYTHENE, scrap and virgin material in large quantities urgently wanted, best prices paid. Please offer with samples to: Herbert Connor, 120 Beaufort Park, Falloden Way, London, N.W.11. 176-27

CONSIDERABLE QUANTITY OF PERFORATED BAKELITE (Delaron), in sizes 9 ins. wide by 4 ft., 6 ft. and 8 ft. lengths, 3/32 in. perforation, price 1s. per sq. ft. Samples on request to The Valley Supply Co., Ltd., Bridge End Mills, Whitworth, Rochdale, Lancs. Phone, Whitworth 52162. 176-9

POLYSTYRENE AND ACETATE MUZZLE SPUES in quantities for sale. Please write to Box P7628, care of " Plastics." 176-40

WHITE GROUND POLYSTRENE, approximately 3,000 lb., for disposal. Inquiries invited. Box P7627, care of " Plastics." 176-39

A. E. GOODEVE, LTD. offer immediate deliveries of ebonite, casein, laminated bakelite in rods, sheets and tubes. Also cellulose acetate tubing, clear and coloured. A. E. Goodeve, Ltd., 188a Seven Sisters Road, N.7. Archway 3654. 187-2855

P.V.C., polystyrene and cellulose acetate scrap continuously for sale. Inquiries invited. Herbert Connor, 120 Beaufort Park, Falloden Way, London, N.W.11. 176-28

VARIETY OF INJECTION MOULDS for sale, good condition. Toys, household goods. Box P767, care of " Plastics." 181-2853

BLACK CELLULOID SHEETS, approximately 4½ tons for sale, 50 ins. by 20 ins. by .130-in. thick, polished both sides. Box P7411, care of " Plastics." 176-36

FOR SALE, 10 tons Phenol Formaldehyde moulding powder, 3 tons paper-filled Urea, manufactured by leading suppliers. For further particulars apply to Box P763, care of " Plastics." 176-35

ACETATE SHEET, pink .010, .020, green .010, stocks surplus owing to discontinued production for sale at considerable reduction on cost. Box P766, care of " Plastics." 176-32

ASSORTED MOTTLED COLOURS CELLULOSE ACETATE, 300 lb., in sheet 4 mm. thick, 21 ins. by 18 ins., and 390 lb., in rod 4¾ mm. dia. 24 ins. long. Details of colours and price from Box P768, care of " Plastics." 176-31

CELLULOID SHEETS and cellulose acetate sheets, various colours and thicknesses as surplus, for sale. Please write to Box P7615, care of " Plastics." 176-25

CRYSTAL-CLEAR REGROUND ACRYLIC, regularly available. Box P7621, care of " Plastics." 176-20

PHENOLIC MOULDING POWDERS, currently available at 1s. 11d. lb. Box P7620, care of " Plastics." 176-19

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REPROCESSED RED/BROWN P.V.C. COMPOUND, 1s. 1d. lb. Box P7618, care of " Plastics." 176-17

Raw Material Available and Wanted (contd.)

1,000 YDS. WHITE P.V.C. SHEETING, linen grain, 20 thou., special bargain at 5s. 4d. per sq. yd. Box P7617, care of " Plastics." 176-16

CLEAN P.V.C. FINE SHEETING OFF-CUTS, 1s. 1d. lb. Box P7616, care of " Plastics." 176-15

RIGID P.V.C. I.C.I. SHEET, 30 ins. by 30 ins. by ⅛ in., white, 75 sheets for disposal, 35s. per sheet. Box P7626, care of " Plastics." 176-x1173

FOR DISPOSAL—offers invited:—6 cwt. Cellomold, red; 4 cwt. BX cellulose acetate, pink; cellulose acetate, ¾ cwt., cream; 1 cwt. black, 1½ cwt. dark shell, ¾ cwt. clear. Diakon—1 cwt. 13 clear 100 G.; 4 cwt. 13 red 460 G.; 1 cwt. Amber 19; 1 cwt. blue 19; 2½ cwt. green 660 G.; 1 cwt. green 19. Box P7623, care of " Plastics." 176-x1297

SITUATIONS VACANT

The engagement of persons answering advertisements in respect of vacant situations must be made through a local office of the Ministry of Labour, or a scheduled employment agency if the applicant is a man between the ages of 18 and 64 inclusive or a woman between the ages of 18 and 59 inclusive, unless he or she, or the employment, is excepted from the provisions of Notification of Vacancies Order, 1952.

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SALES MANAGER required by company which has increased its moulding compound production and requires services of a gentleman with knowledge and connections in the thermoplastics industry, able to increase home and export sales. Permanent interesting position with good prospects. State in strictest confidence age, experience, salary required. Box P7629, care of " Plastics." 176-41

AGENT WANTED for manufacturer of plastic showcards, etc. Rep'y Box P7622, care of " Plastics." 178-2852

WORKS MANAGER wanted for leading plastics manufacturers at their works in South-East Scotland. Applicants should be fully qualified in the calendering and extrusion of P.V.C. materials and should be capable of taking complete charge of men engaged on this work, being a good disciplinarian with employees of both sexes. Apply in strictest confidence, giving details of age and qualifications, also salary required, to Box 450, Robertson and Scott, Edinburgh, 2. 176-4

BRITISH ARTID PLASTICS, LTD., SLOUGH, require salesman for London area. Experience in plastics industry essential. Please send application, giving full details to J. Severn, Sales Manager. 176-2

PRODUCTION MANAGER wanted with experience in injection moulding assembling and possibly in buying. Good salary and prospects for energetic practical man. Apply Secretary, Airfix Products, Ltd., Haldane Place, Garratt Lane, S.W.18. 176-5

WANTED, chief engineer capable of taking charge of injection moulding plant and toolshop. Permanent post for highly skilled man with sound experience of mould design and moulding techniques. Good salary and prospects. Apply Secretary, Airfix Products, Ltd., Haldane Place, Garratt Lane, S.W.18. 176-6

RESINOID AND MICA PRODUCTS, LTD., Colonial Works, Mary Street, Balsall Heath, Birmingham, 12, require the following additional personnel:—
Draughtsman, experienced in designing compression and injection tools.
Estimator with several years' experience in the plastics industry.
Good salary and conditions. Apply in writing to the General Manager. 176-8

TECHNICAL REPRESENTATIVE required with own car for modern fast-expanding plastic company, in London area. Experience and useful contacts an asset. Write giving full details to Creators, Ltd., King's Road, New Haw, Weybridge. 176-10

BRITISH RESIN PRODUCTS, LTD., have a vacancy for a chemist or technician, age 25-35 years, preferably with many years' experience of moulding shop practice, thermosetting and thermoplastic materials, and capable of initiating and supervising comprehensive investigations of moulding problems. Salary will depend on experience and qualifications. Apply to Staff Manager, the Distillers Company, Ltd., 21 St. James Square, London, S.W.1. 176-11

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Oil is a basic raw material at I.C.I.'s Wilton Works, where there are plants for the manufacture of 'Alkathene', 'Perspex' acrylic sheet and 'Mouldrite' thermosetting moulding materials. These gas storage tanks at Wilton contain ethylene—the raw material for 'Alkathene'—made from oil by Wilton's vast oil cracker and gas fractionating plant, part of which can be seen in the background. This plant produces other raw materials for the synthesis of I.C.I. plastics.

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